

SCIENCE.

FRIDAY, MAY 16, 1884.

COMMENT AND CRITICISM.

THOSE interested in making out the connection between the periods of recurrence of the solar spots and every kind of meteorological phenomena, crops, panics, and the like, will derive little that is comforting from the unusual spottedness of the sun's surface of late. Just as astronomers may be said to have concluded that the sun-spots wax and wane according to some pretty regular period, the length of which appeared to be determined with a fair approach to the desired accuracy, the sun itself interrupts the continuity of their successful prediction by an abnormal lagging of the present maximum: for the epoch of this phenomenon, as inferred from the best interpretation of the records of the past, lies somewhere in the year 1882, or the early part of the year following. In point of fact, there appears to be ground for doubting whether the true maximum may not, even now, be a thing of the future.

Rather less of encouragement will those astrophysical theorists of sun-spot periodicity receive who stand stoutly for the notion that the increase and decline of the spots are traceable to planetary position and influence, even if there were no other spot-phenomena, which this theory is powerless to explain. And the meteor-origin theorists are in almost equal difficulty. On the other hand, the more plausible explanation of this periodicity — that the solar globe determines within itself, and independently of all exterior perturbing action, the extent and duration of the absence or prevalence of the spots on its surface — receives re-enforcement rather than otherwise from the present manifestations of spot-activity; for, on this theory, the periodicity is more likely to be irregular than the reverse. The new periods of short duration, discovered by Professor

Stewart, are likewise, on this same basis, accounted for most easily, and with greater accuracy. The likelihood that solar energy, as displayed in spot-production, has been on the increase during the year 1883, and the certainty that it has not largely waned since that time, render it very probable that we have not yet accumulated sufficient data for deciding with exactitude upon the true epoch of the present spot-maximum.

D. H. TALBOT of Sioux City, Io., has addressed an open letter to the Hon. W. B. Allison to advocate the establishment of a zoölogical preserve within the boundary of the Yellowstone Park, where bears and deer shall be enticed to breed and abide, defended by a guard from human encroachment. There is to be an honest, competent observer in charge, who is to make notes, which may "be published in like manner as the reports of the Smithsonian institution." Mr. Talbot's scheme is vague; its opponents will call it visionary: nevertheless, we entirely agree with him as to the interest and value of reserving some territory where our large mammals may be secure from extirpation; but we do not feel assured, that if, as Mr. Talbot proposes, three species of bears are to be brought within one comparatively small territory, together with some ten other animals, mostly deer, all the happy family will survive the intensified struggle for existence. Nevertheless, Mr. Talbot's scheme is a valuable suggestion, which we trust will receive careful consideration from the proper authorities.

SHORTLY after the announcement of the law of storms by Dove and Redfield, fifty years ago, mariners became familiar with the expressions 'dangerous' and 'manageable semicircle,' referring to the sides of the storm-disk where the velocity of the winds was respectively re-en-

forced and diminished by the progression of the storm. But on lands in the temperate zone these terms have had little application; for there cyclones proper are seldom destructive, and, as a general thing, do less harm by their winds than they do good by their rains. There will, however, soon be need, at least in our western and southern states, of a corresponding expression, such as the 'dangerous octant,' to denote the sector between south and east of the broad storm where local tornadoes may be developed; for the surmise that tornadoes were thus definitely related to cyclones, suggested by the signal-service studies of a year or two ago, is rapidly becoming a well-proved fact by the investigations of this season. It is the most interesting discovery in meteorology that has been made of late years, in its theoretical as well as in its practical bearings.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Radiant heat.

In his letter to *Science* of the 15th of February, Professor Eddy states, that, in his opinion, the direction of the rays entering the region *B* is immaterial. As I am sure no other American or other scientific man agrees with him, I do not think it worth while, now that the issue has been reduced to this question, for me to continue a correspondence of the kind across the Atlantic, especially as Professor Eddy's mistakes have already been pointed out by Professor De Volson Wood.

As I am writing, I may, however, as well point out Professor Eddy's mistake in the arrangement he proposes as a substitute for mine. I agree that fig. 1 and fig. 2 represent what would happen; but fig. 3 does not represent all that would happen, as evidently, if heat can go into *B* in the direction $y'z$, as in fig. 2, there would be an escape of heat from *B* in the direction zy' , as well as that in the direction zy represented in fig. 3; and so, to the two quantities of heat coming into *B* in fig. 2, there would escape two equal quantities, which should have both been represented on fig. 3; and then, evidently, *B* is no better off than before.

Professor Eddy, I hope, will recollect that a pencil of rays of infinitesimal angle can only contain an infinitesimal quantity of heat. I make the remark because an omission to notice this fact is the only excuse I can see for the curious remark in the penultimate paragraph of his letter.

GEO. FRAS. FITZGERALD.

Trinity college, Dublin.

Another 'yellow day'

On the afternoon of May 2 a strong wind from the south-west brought to our position (seven miles

due west of West Point) thick clouds of smoke from the forest-fires in Pennsylvania and northern New Jersey. At 4.15 P.M. the sun had become completely obscured, and occasionally cinders and bits of charred leaves were borne past by the wind. The increasing density of the smoke was accompanied by a strange brassy, yellow light, which grew more vivid as the sun disappeared, and was most brilliant from five to six o'clock. It pervaded the whole sky with a diffused brassy glow, which was reflected into interiors so that an object placed before a window cast a perceptible shadow, yet the actual amount of light was less than in ordinary foggy or cloudy weather. The flame of a student-lamp had a white, dazzling appearance, not unlike the electric light. The green color of grass and foliage became of a most vivid quality, and the various shades of red seemed unusually prominent. This was attended by a high wind of from thirty to forty miles per hour, the highest temperature of the season, falling barometer, and a remarkably low percentage of relative humidity, as the following records show in part:—

Hour.	Temperature.	Relative humidity.
1 P.M.	81.0°	44%
2 "	82.0	38
3 "	81.5	33
4 "	81.0	22
5 "	80.0	15
6 "	67.0	42
7 "	61.0	45

The noteworthy feature of the phenomenon was its similarity to that of the well-remembered 'yellow day,' Sept. 6, 1881, the explanation of which was the subject of so much discussion. But, since the cause of the later occurrence was so unmistakably the presence of smoke in the air, persons who witnessed both can have little doubt that the same cause operated in the former case.

WINTHROP E. STONE.

Houghton Farm, Orange co., N.Y.

Cretaceous phosphates in Alabama.

I send you by mail some specimens of phosphatic nodules recently discovered in Perry county, in this state. Their true character was first suspected by Mr. William Spencer, on whose land they are found in abundance. Specimens were sent by him to Dr. C. U. Shepard, jun., of Charleston, S.C., and to myself, for examination, with the result of showing that they were nearly pure phosphate of lime. The geological position of this occurrence is different from that of the South-Carolina phosphates, as they are found at the base of the cretaceous rotten limestone; but the mode of occurrence is quite similar, as may be seen below.

A section (descending) of the strata at Hamburg, in Perry county, is about as follows:—

1. Rotten limestone, only the lowermost beds of which are here present.

2. Greensand beds from one to four or five feet in thickness. These beds appear to be impregnated with phosphoric acid; analyses of several specimens, selected from different spots, showing an average of about twenty per cent.

3. Sandy, calcareous beds about six feet in thickness. Where these beds outcrop in the fields, the surface of the ground is covered with nodules similar to the specimens sent herewith. These nodules

vary in size, from small pebbles no larger than a pea, to pieces an inch or more in diameter. They are of very irregular shapes, and of colors varying from light bluish gray to dark brown. When rubbed together, they emit the peculiar 'naphthous' odor which characterizes the South-Carolina phosphates. I collected and weighed the loose specimens from a square foot of surface: the weight was about two pounds, which would correspond to some forty-three tons to the acre. I was not able to ascertain whether the nodules were distributed through the whole of stratum no. 3, or whether they were confined to a distinct layer therein, though a number of sections were examined; nor can I as yet state the probable yield per acre in these nodules, but investigations are now in progress which will probably soon give some more definite information on this point. Associated with the nodules are great numbers of fossils, consisting of fragments of Nautili, of Ammonites, of Baculites, and other well-known cretaceous forms. In most instances these fossils are phosphatized more or less completely, in extreme cases to the extent of nearly obliterating the organic structure; and then the fossils resemble the nodules very closely. In addition to these are found many vertebrae, and other bones of saurians, and teeth of sharks, among which are some very large 'pavement' teeth. I have had several analyses made of the nodules, and find the content of phosphoric acid to be from twenty-five to thirty-eight per cent.

4. Indurated ledge of light-colored sandy marl from a foot to eighteen inches in thickness. This stratum, which is quite persistent, holds about ten per cent of phosphoric acid, the average of several analyses of samples taken from different localities.

5. Loose whitish calcareous sands, passing downwards into micaceous sands, and, at the depth of twenty to thirty feet below the ledge no. 4, passing into compact bluish sands, with considerable greensand.

The whitest sands, at the top of these beds, hold in places compact beds of small oyster-shells. The sands just below the ledge no. 4 are also impregnated with phosphoric acid; and, though no quantitative analysis has yet been made, the percentage, judging from appearance, cannot be less than ten. We have thus eighteen or twenty feet of strata charged with phosphoric acid; the content of this acid varying from ten per cent in the lower beds, to twenty per cent in the greensand at the top. No analyses have yet been made of the beds which hold the nodules.

Of the economical importance of this discovery it is as yet impossible to speak definitely, but, if the greensand beds can be made available, the yield will be very large; and the nodules may yet be found in compact masses instead of loose pebbles.

It is probable that phosphate beds, in similar geological position, may be traced across the state; and already some greensands from Eutaw have been analyzed, and found to contain eight per cent of phosphoric acid. The following towns are situated near the line of contact of the rotten limestone and the underlying sandy strata: Tuskegee, Montgomery, Vernon, Autaugaville, Burnsville, Summerfield, Hamburg, Greenvboro, Eutaw, Clinton, Pleasant Ridge, Bridgeville, and Pickensville in Alabama, and Columbus, Aberdeen, Cotton-gin Port, Guntown, Baldwin, Booneville, Rienzi, and Farmington in Mississippi; and it is well worth while to search along this line for other occurrences of phosphates, especially where the saurian bones and sharks' teeth are abundant.

EUGENE A. SMITH.

University of Alabama, May 3.

A blind fish from the Missouri River.

An old fisherman on the river brought me yesterday an anomaly which none of his craft had ever seen before. It was a shovel-nosed sturgeon (*Scaphirhynchops platyrhynchus* (Raf.) Gill), which exhibited on the surface no sign whatever of eyes. These were concealed by a complete overgrowth of the prickly skin, which, on casual examination, differed in no respect from its normal appearance elsewhere. Upon very close inspection, however, a slight indentation, like a small pin-prick, was found to mark the place where one eye ought to be, but it did not penetrate the skin; and even this could not be detected over the other eye.

I skinned and mounted the fish, and, after skinning, removed the eyes from the inside through the mouth and gill openings. In one of these I could detect nothing abnormal. The other was without the crystalline lens, though the cornea and iris were apparently in place when I took it out; but, as it was removed with considerable difficulty, the lens *might* have been pressed out in the process. The first-mentioned eye was taken out with more care and less difficulty, and was entirely uninjured.

The sturgeon was normal in every other respect, twenty-five inches long to the tail, and showed no sign of injury to account for the monstrosity. It was in as good physical condition as others of its kind, so far as I could see, and seemed to have labored under no unusual disadvantage in its struggle for existence. The alimentary canal contained several insect larvae, the only contents that could be recognized. Most of these were so far digested as to be beyond identification. One, about an inch long, had rudimentary mouth-parts and no legs, and might have been a dipterous larva. Two fragments resembled the larva and pupa of some Lampyridae. Another was a lamellicorn beetle larva, probably of *Lachnosterna fusca* Fröhl.

As the habit of this sturgeon is to plough in the mud for its food, and to use its tactually sensitive barbels, with perhaps the soft skin covering the under surface of its shovel-nose, as a substitute for sight, it can have but little use for eyes: hence they might about as well be covered with skin, or become rudimentary, as those in the blind fishes, cray-fishes, etc., in Mammoth Cave and in certain subterranean streams and ditches, and for the same reason.

The eyes of this species are very small for its size, and especially small as compared with the eyes of most fishes. So the mole has its eyes reduced to a mere speck, which doubtless, as Mr. Huxley says, 'have no functional use.' It seems, therefore, not unreasonable to suppose that this unfortunate sturgeon's closed and sightless eyes may be only a prophetic instance of the fate which *awaits* all that belong to this species, and that even the normal eye is already considerably advanced in the process of abortion.

S. H. TROWBRIDGE.

Glasgow, Mo.

The use of the method of rates in mathematical teaching.

In regard to the communication of Professor Johnson, in your issue of April 18, p. 473, he admits that he is puzzled by the form of the questions which he assumes I put into the mouth of my students. I had no intention of puzzling him; and, in regard to the questions, they were real samples of those proposed by students from time to time. Not that all were asked by one student, or during one discussion, nor limited to those given.

My students have not asked me "whether the positive and negative parts of the axis of x are separated by a point, or by a space." Their difficulty does not appear to be with permanent statical conditions, but rather with the conditions involving change of motion, either of direction or change of rate; and since *rate*, in this discussion, involves motion, we fail to see the force of the question.

Professor Johnson expresses the opinion that the difficulty in the question, "Does the change in the rate of motion take place *at* an instant, or *during* an instant?" will disappear if 'during an interval' be substituted for 'during an instant.' We do not object to the substitution if it will relieve the difficulty, but to us it only enlarges it. It may be asked, How long is the interval? If ever so small, is the rate variable *during* the interval? If variable, the original question arises, and we wish to know if *change* involves a *part* of the interval; or, to adopt as nearly as possible the language of the professor, does change in the rate take place at 'a point' in the path, or during 'a space' of the path? If at 'a point,' is it not equivalent to asserting that a change takes place in no time? and if an interval is necessary, must it not be conceived as infinitesimal? Answers to these and similar questions may enable one to decide whether the fundamental conception of rates is more simple than that of the infinitesimal method. I do not question the soundness of the method of rates; and no avenue to the acquirement of knowledge should be closed to the student, even if all are not agreed that it is the 'fittest.'

DE VOLSON WOOD.

Hoboken, May 8.

THE NAUTICAL ALMANAC OFFICE.

THE conduct of the affairs of the office of the American ephemeris and Nautical almanac under the *régime* of the present superintendent, is worthy of special note in the progress of astronomy at home. Formerly this office did very little toward the collection and discussion of data for improving the tables of the celestial motions, expending nearly the whole of its annual appropriation by congress in the preparation of the Almanac and the Ephemeris from such tables as were afforded by the labors of astronomers everywhere, and, with few exceptions, not connected with the office itself. During the past seven years, however, not only has the efficiency of the office been greatly promoted by having nearly, if not quite, all the planetary ephemerides prepared by a single expert computer under the immediate direction of the office, and by a similar concentration of work and workers in other departments where formerly the computations were executed by individuals in different parts of the country not under the direct supervision of the superintendent, but the policy of the office with regard to the conduct of original investigation has been greatly modified; and, although the increase of the annual appropriation has

been very slight, an immense amount of astronomical research has been completed and published; and, as we learn from the published papers and reports of the office, the work, now well progressed and projected for the future, is of a character even more important and extensive. The valuable series of 'Astronomical papers prepared for the use of the American ephemeris and Nautical almanac,' the third volume of which has just begun with the publication of Professor Newcomb's development of the perturbative function, has for its object a systematic determination of the constants of astronomy from the best existing data; a re-investigation of the theories of the celestial motions; and the preparation of tables, formulae, and precepts for the construction of ephemerides, as well as for other applications of the results. The papers already published in the second volume, and the six parts of the first volume completed some time ago, are such as conduce only to the object in view, and range over a vast field of astronomical inquiry, from the experimental determination of the velocity of light, to Gauss's method of computing secular perturbations. Among the more important works already well in hand, but as yet unpublished, are Mr. George W. Hill's development of the perturbations of Jupiter and Saturn according to the methods of Hansen, on which he has been engaged since 1877; a determination of the mass of Jupiter from the perturbations of Polyhymnia; a re-determination of the velocity of light by the phototachometer; as well as discussions of the older observations of the Sun, Mercury, Venus, the Moon, Mars, and the satellites of Jupiter, with a direct view to a reconstruction of the theories of the motions of these bodies.

Not among the least of the improvements inaugurated by the present superintendent of the office must be noted the material alterations in the form and arrangement of the contents of the American ephemeris, together with the extensive additions made for the first time to the volume for the year 1882; all of which conspire, on the adoption of the new and more accurate systems of planetary tables, to make the Ephemeris in most respects superior to the similar publications of the foreign governments. The administration of the office also gives good evidence that the practical applications of astronomy are kept well in mind; for within a brief period it has commenced the regular publication of the American coaster's nautical almanac, the initial volume of which is adapted to the present year, and which we shall shortly notice.

INDIAN IMPLEMENTS OF THE NORTH-WEST.

A Dakota puk'-gah-mah-gun.

THE illustrations accompanying the present paper represent a Dakota puk-gah-mah-gun, or war-club. The weapon here figured (fig. 1) was formerly owned and carried by the Sioux chief, Black Bull, then a distinguished personage in Sitting Bull's command. By him it was eventually presented as a valuable token of affection and confidence to a young Ojibwa named Mois-ko-ko'-nia ('Red Robe'), toward whom, in accordance with certain intertribal customs, he had previously assumed the relation of adopted father. This title, it should be observed, does not imply actual interchange of filial and paternal duties, but rather expresses the ex-



FIG. 1.

istence of a purely ideal phase of sentimental friendship on the part of the persons concerned. The recipient is now at the head of one of the seven chieftaincies of the Red Lake band of Ojibwas, living upon Red Lake reservation, in northern Minnesota; and he there disposed of the specimen to its present possessor, Mr. Jonathan Taylor, late sub-agent of the Red-Lakers. The weapon in question is undoubtedly, therefore, a genuine Dakota puk-gah-mah-gun. These implements in general are not only used as weapons of

war, but are also carried in the hand in times of peace, as a sort of ornamental appurtenance — much as a cane is sported by the city exquisite.

The head (fig. 2), which is the essential part of this specimen, is wrought from a stone of a quartzose character. It is symmetrical in outline, has a smooth though unpolished surface, and resembles an egg in form. The two ends are shaped alike, however; and they are produced into obtuse points, which are cleverly adapted to deal a most effective crushing blow, upon the skull for instance. Midway between the points, the head is encircled with a groove about five-eighths of an inch broad, and deep enough to receive the slender hoop of wood by which the head is bound to the staff serving it as a handle. The measurements are as follows: greatest diameter of head, three inches and seven-eighths; least diameter of head, two inches and a quarter; circumference of head corresponding to least diameter, measured at the side of groove, six inches and a half.

The stiff, slender staff is thirty inches in length, and averages about three-quarters of an inch in diameter. It consists of a central stem of wood enveloped in a sheath of leather. A section of the central stem, obtained by splitting, appears to be prolonged beyond the

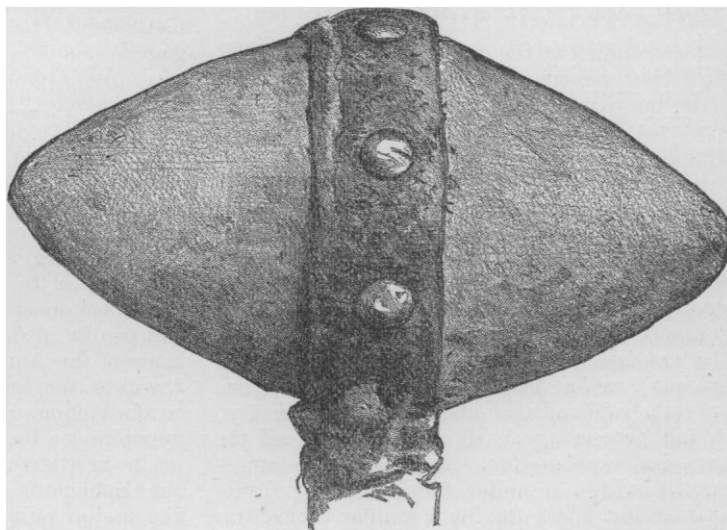


FIG. 2.

staff proper, and, following the groove, to surround the head like a hoop, and extend about twelve inches down the opposite side of the staff; to which, as indicated by certain markings, it is firmly bound. The leathern sheath is simply a strip of hide, closely drawn about

the wood, and overhanded together with sinews in a longitudinal seam. The sheath is terminated at each extremity by a narrow strap: that at the foot of the staff is a mere ornamental appendage. It is perhaps an inch in width by three in length, and is adorned with a tassel of horse-hair attached to it by a leathern string. The upper thong is five-eighths of an inch wide, and encircles the head outside the wooden hoop, following the groove. The free extremity terminates in a long gore, which fits into a corresponding opening at top of sheath, on the side opposite the origin of the thong. It is secured in place by stitches of sinew. An ornamental row of brass-headed nails attaches this thong to the wooden hoop beneath. The straps are cut in one piece with the remainder of the sheath.

The grip, or lower half of the staff, is furnished with a second casing, formed from a belt of bead-work, manufactured of a proper width, and joined along its edges like the inner sheath. This belt is, for the most part, woven in narrow alternating stripes of green and of white beads. The top of the grip, however, consists of a broad band of white, upon which, done in green, figures an Indian, adorned with an eagle-plume, and holding in one hand something, perhaps, intended to simulate a tomahawk. The ribbon attachments shown in the plate have been added by the Ojibwas. Possibly the bead-work envelope may also have been contributed by the latter, as the Ojibwa women are most expert in the art of needle-weaving.

Ojibwa bone-breakers.

I am informed by Ojibwas¹ competent to speak in the matter, and also by other authorities, that an instrument corresponding in several particulars with the one above described was formerly commonly employed for domestic purposes among the Ojibwas. The latter implement is said to be actually in use at the present time, at isolated points where bands, or parts of bands, are yet living, practically, in the 'stone age.' The Ojibwa utensil is named a bone-breaker. It is a coarse implement, having a roundish form, without pointed extremities. It is furnished with a groove, like the Dakota specimen, and it is much the same with that weapon in general size. The stone head is attached to the handle by methods identical with those used in binding the head to the central stem of the puk-gah-mah-gun.

The head of the bone-breaker appears to be the counterpart of a small stone object described and figured by Dr. C. C. Abbott, in his 'Stone age in New Jersey' (see his fig. 312). At least, this figure has at different times been pointed out to me as a bone-breaker by intelligent elderly Ojibwas of Red Lake reservation, to whom, during a summer spent at their agency, I took occasion to exhibit certain of the plates in Dr. Abbott's book.

Very explicit and interesting statements concerning this implement were made by various persons, and particularly by the missionary in charge, Rev. Fred. Smith, an Ojibwa brought up as a 'blanket Indian,' in what is now central Minnesota. In his early youth, Mr. Smith had frequently seen the bone-breaker in service in the family lodge. He had occasionally met with implements of the sort elsewhere, though they have, of late years, fallen into general disuse; but he believed that such were still used by the Red-Lakers of the north shore who are remote from the agency. He had never known this utensil to be employed as a weapon, and thought Dr. Abbott's figure was undoubtedly a bone-breaker. It was used for breaking the bones of game when they could not be parted readily with a knife; as, for instance, in dividing the spoil of hunters, in cutting up meats for cooking, or in distributing food to one's family.

FRANC E. BABBITT.

THE CRUISE OF THE ALBATROSS, FROM CURAÇOA TO ASPINWALL, IN FEBRUARY AND MARCH.¹

WE left Curaçoa at 7.20 A.M., on Feb. 18, and ran a line of soundings in a southerly direction to the mainland, the greatest depth found being 738 fathoms. The government and people of Curaçoa will watch with peculiar interest the result of this line of soundings, as it will go far towards solving the problem of procuring a much-needed supply of fresh water by sinking artesian wells.

The relation this island bears to the mainland has been heretofore unknown; the general impression being that it was an isolated volcanic peak, having no connection with the watershed of the contiguous coast of Venezuela. In this case, water would not be found by sinking artesian wells: on the other hand, if connected with the main by a plateau or neck of land

¹ Ojibwas, or Chippewas. The former term is that by which these people designate themselves: the latter is our corruption of that name.

¹ Abstract of the official report of Lieut.-Commander Z. L. TANNER, commanding, to Prof. S. F. BAIRD, U.S. fish-commissioner. Received through the courtesy of Professor Baird.

having a moderate depth of water over it, wells might be sunk with a fair probability of success. An effort was made recently, by the colonial government, to ascertain the depth of the channel, but without success.

During the afternoon we made a haul of the dredge in 122 fathoms, and of the trawl in 208 fathoms, in the channel above mentioned, with but moderate success. A few specimens were, however, secured from both hauls. The small amount of life on the bottom of the Caribbean, compared to that off the New-England coast, has been a constant surprise to me during the cruise.

At 1 A.M. the following day a course was made north-north-west for Alta Vela, a small island on the south coast of San Domingo. Soundings were taken at intervals of 10', 20', and 25'; and at 9.10 A.M. we sounded in latitude $13^{\circ} 17' 45''$ north, longitude $70^{\circ} 1'$ west, with a depth of 1,701 fathoms, the bottom composed of foraminiferous ooze and coarse sand. The small beam-trawl was landed on deck, with a few sponges, shrimp, small fish, etc., indicating any thing but rich ground. On the morning of the 21st we passed a few miles to the westward of Alta Vela, and laid a course north-west for Cape Jacmel, sounding at intervals of about 16'.

The deepest water found between Curaçoa and San Domingo was 2,694 fathoms, in latitude $13^{\circ} 40' 20''$ north, longitude $70^{\circ} 10' 45''$ west. The bottom was brown ooze, without a trace of foraminifera. The average depth was about 2,300 fathoms until within a short distance of the land, when it shoaled rapidly to 302 fathoms four miles south-west of Alta Vela, deepening again to 2,410 fathoms 20' west-north-west of the island; the next sounding, 16' distant north-west by west, revealing 2,434 fathoms, — the greatest depth between Curaçoa and Aspinwall, with the single exception before mentioned.

The line was extended to Jacmel, showing bold water to the cape; then 60' south, crossing a ridge which extends westward from Alta Vela. We then ran a line north-west 40', crossing the line of the ridge above mentioned, but found it had terminated, or changed its direction, as we carried a uniform depth of about 2,400 fathoms. We then steamed 18' west-south-west, and sounded in 2,490 fathoms, brown ooze, latitude $17^{\circ} 39' 30''$ north, longitude $73^{\circ} 22' 15''$ west; 'Leighton rock awash,' hydrographic-office chart No. 36, being located in latitude $17^{\circ} 37'$ north, longitude $73^{\circ} 21'$ west. After another run of 15' north-west by west, we sounded in 2,369

fathoms, brown ooze, latitude $17^{\circ} 48'$ north, longitude $73^{\circ} 34' 15''$ west; 'Loos shoal' being placed in latitude $17^{\circ} 45'$ north, longitude $73^{\circ} 30'$ west, hydrographic-office chart No. 36. These shoals were searched for in 1872 by H.M.S. *Philomel* and *Plover*, and, as they were unable to find them, they were expunged from the admiralty charts; but, being still shown on hydrographic-office charts, I considered it advisable to settle the matter beyond all dispute by ascertaining the actual depth in the localities assigned them.

Another sounding was taken 9' south of Point Abaou, in 1,039 fathoms, and then a line run 30' west, sounding every 10'; then north-west 13', and south-south-west 53', sounding at intervals of about 15' for the purpose of eliminating a large number of negative soundings appearing on the chart, and also to examine two shoals referred to in hydrographic-office publication No. 63, as follows: "More recent soundings of 16 fathoms have been reported in latitude $17^{\circ} 45'$ north, longitude $74^{\circ} 39'$ west, and also in latitude $17^{\circ} 13'$ north, longitude $74^{\circ} 58'$ west." We found 803 fathoms within three miles of the former position, and 1,120 fathoms on the position assigned to the latter, demonstrating conclusively that shoal-water does not exist in the positions named. It is highly probable, however, that much less water may be found west and north of this locality.

From our last position we ran 15' north-north-west, and sounded in 968 fathoms; then changed the course to north by east for 70', sounding at intervals of about 15', except in one case, when a sounding of the Blake intervened. A reference to this line will show the bottom to be very uneven in this locality; and a depth of 262 fathoms in latitude $18^{\circ} 18' 30''$ north, longitude $74^{\circ} 53' 30''$ west, about 10' south-east by east from Navassa, is something of a surprise. The water deepens to 1,040 fathoms 15' to the northward and eastward of the island, and to 1,347 fathoms 8' north-west of Cape Dame Marie. From this point we ran east by north 60', sounding at intervals of 20'; the second cast giving us 1,974 fathoms, and the third, 342 fathoms, about 10' to the westward of Gonave Island. From this point we steamed north by east 20', where we found 800 fathoms, and 20' west by south 502 fathoms, which was, of course, a surprise. From this point we ran a line west-north-west 76', sounding at intervals of 20'. The maximum depth found in the windward passage was 1,923 fathoms.

At 12.40 P.M., Feb. 25, we sounded in 1,639

fathoms, green sand, latitude $19^{\circ} 45'$ north, longitude $75^{\circ} 4'$ west, took serial temperatures, and at 2.40 p.m. put the trawl over, veering to 2,400 fathoms, landing it on deck again at 6.55 p.m., having made a successful haul. There were a variety of sponges, some very large shrimp, one fish, numerous shells, small crabs, holothurians, and an interesting octopus, the arms all of the same length, and connected by a membrane. The color was cherry-red on its head, changing gradually darker towards the extremities.

Feb. 27, we stood out of the harbor of Santiago de Cuba, and made ten hauls of the tangles in search of *Pentacrinus*. Several hauls were made before we succeeded in getting a specimen: finally, however, we procured four fine ones in perfect condition.

We next ran a line south-south-east $93'$, in the direction of Navassa, sounding at intervals of $10'$ to $20'$. The maximum depth, 2,275 fathoms, was found $44'$ from Santiago de Cuba lighthouse, gradually decreasing to 870 fathoms about $6'$ from Navassa, from which point we ran a line west $30'$, sounding at intervals of $15'$; the first cast giving 1,015 fathoms, and the second 620 fathoms, $7'$ east from Formigas banks. A line was then run south-south-west $50'$, sounding at intervals of about $12'$. The greatest depth, 1,153 fathoms, was found midway between the banks and Morant Point, the last cast on this line giving 450 fathoms, $10'$ east-south-east from the light, which was in full view. Having located the ship accurately with reference to the above-mentioned light, we started ahead at 4 a.m., running a line east-south-east, sounding at short intervals, towards a shoal marked as follows on hydrographic-office chart No. 35: 'Eight shoal.' We found 21 fathoms on the northern end of the shoal, east-south-east about $32'$ from Morant-Point lighthouse, inlet $17^{\circ} 44'$ north, longitude $75^{\circ} 50'$ west. It is about $9'$ in length north-north-east and south-south-west, and from $3'$ to $4'$ in width. The least water found was $17\frac{1}{2}$ fathoms.

Leaving the southern edge of the bank, we ran a line west by north $58'$, sounding at various intervals. The depth of water found, at the first cast south-east of an 18-fathom sounding on the edge of the bank, was 360 fathoms, increasing to 838 fathoms $3\frac{1}{2}'$ to the westward; the greatest depth on the line, 875 fathoms, being reached $4'$ farther to the westward, from 400 to 700 fathoms being found throughout the remainder of the line. Port-Royal light bore north-north-west $7'$ distant, at the last sounding on the above line, which gave 484 fathoms.

Another and the last cast before entering port gave 400 fathoms, $2'$ north-west by north from the position above mentioned, and quite near the bank. Having passed quarantine, we went on to Kingston, where we anchored.

During our stay here, we had several dry days in succession,—an unusual occurrence since our arrival in the Caribbean. The naturalists were busily engaged in collecting while in port, and found it excellent ground, the best, in many respects, that we have found in the West Indies.

On the morning of the 11th of March, we again proceeded to sea. Arriving near the edge of the bank, we put the tangles over; but, unfortunately, they fouled on the coral bottom, and were lost. We then ran a line of soundings south $15'$, sounding at varying intervals, crossing the centre of California bank in 26 fathoms. At 6.40 p.m. we sounded in 966 fathoms, sand, latitude $17^{\circ} 36' 10''$ north, longitude $76^{\circ} 46' 5''$ west, and put the trawl over, landing it on the bottom at 8.20, and on deck at 10 p.m., after a successful haul. One rather remarkable specimen was a large earthenware jar, with its surfaces pretty well covered with worm-tubes.

We steamed about $5'$ to the north and east during the haul, and, starting from that point, ran a line directly to Morant Cays, east-south-east $42'$, sounding at short intervals. At 11.45 a.m., March 12, anchored in 4 fathoms, under the lee of north-east Cay. At 8.35 p.m. we turned our head to the southward, and ran a line south by east about $140'$, to a group of negative soundings, in the midst of which we cast the trawl in 2,295 fathoms. We then continued the line about south-south-east, in the direction of Santa Marta, and, finding no indications of shoal-water, passed about $12'$ to the westward of Santa-Marta lighthouse, sounding at frequent intervals as we approached the coast; then stood off north-west $35'$, sounding at intervals of $15'$; then south for the mouth of the Magdalena River and Savanilla, anchoring off the latter place at 8.28 a.m., March 16.

The sounding-wire parted several times during the night of the 11th, and morning of the 12th, in a most unaccountable manner; losing either lead or sounding-rod, and a thermometer, with more or less wire each time. We were inclined to blame the splices at first, but soon found that we must look farther for the cause. In the mean time, we changed wheels, leaving the solution of the mystery until the following day, when, after reeling the wire off, the drum was found to be collapsed. The metal was neither broken nor cracked; but the centre simply

settled down on the bolts, the sides retaining their form. There would have been little or no harm arising from this; but the edges of the drum drew away from the sides, leaving sufficient space for a turn or two of wire, which became so firmly fixed in wheeling in, that it would part before clearing itself when sounding. This condition was caused, probably, by slack turns from time to time, when taking very deep soundings.

We were unable to examine the bar at the mouth of the Magdalena River because of the high winds.

The government of the republic and people of Barranquilla realize the necessity of providing a more practicable outlet for their great river; and, with this end in view, surveys have been made for a deep-water terminus of the Bolivar railway.

We left Savanilla at 8.15 A.M. on the 22d, and ran a line of soundings west 52', to the position in which the U. S. S. Powhatan reported shoal-water, where we found 1,175 fathoms, the water having deepened regularly since leaving port. From this point we ran a line south 40', and being then 16' west by north from Cartagena lighthouse, in 825 fathoms, we stood offshore west-south-west 43', then south-south-east 51', to a point 7' north-west of Puerte Island, where we found 38 fathoms. Soundings were taken at intervals of 10' to 15' since leaving Savanilla: the change in depth was gradual, making it extremely improbable that shoals exist outside of the shore reefs. At 3.30 P.M. we started on a line west, sounding at intervals of 5' to 20', crossing the bay at the bottom of which lies the Gulf of Darien. At 4 P.M. we cast the trawl in 42 fathoms, green mud, latitude 9° 30' 15" north, longitude 76° 20' 30" west, and at 4.55 another haul was made in 155 fathoms, green mud, latitude 9° 30' 45" north, longitude 76° 25' 30" west, both hauls furnishing us with a small number of good specimens.

The line was continued, sounding at various intervals, to Aspinwall, where we arrived at 2.55 P.M., March 25. The strict quarantine observed in this port, because of suspected yellow-fever, will, of course, prevent our naturalists from making collections which I expected would be the most fruitful owing to the facility with which they could reach the interior by the railroad. The return home of Ensign A. A. Ackerman will restrict our investigations, as he has taken the branches of geology and mineralogy during the cruise.

We expect to sail to-morrow, April 2, running a line of soundings to Old Providence

Island, thence to Cape San Antonio, and to arrive in Key West about the 14th instant. [See Notes for account of the next cruise.]

THE OLDER WIND-CHARTS OF THE NORTH ATLANTIC.

THE series of charts of the North Atlantic now in preparation at our hydrographic office, of which three monthly sheets are just issued, recalls the famous work of Lieut. Maury, thirty years ago, with which our approach to a precise knowledge of ocean meteorology began. Current-charts go back to 1678, when the first one for the Atlantic was published by Kircher,¹ and the general circulation of winds was roughly shown as long ago as in the map by Dampier,² of a little later date; but these, and all their successors down to comparatively recent years, were based only on general records, and not on the systematic apportionment of observations to definitely limited small areas of the ocean. The method of 'squaring' observations began with the English hydrographer, Rennell, about 1830, but was not then carried very far, and waited for its full expansion till taken up by the enthusiastic Maury. The remarkable series of charts published by him about 1850, for the Atlantic and Pacific Oceans, marks an epoch not only in our knowledge of the ocean, but in the progress of inductive meteorology; and the greater number of wind and current charts published since that time are taken very closely from his results.

The improvement in this kind of work during the past fifty years has been not only towards greater accuracy, as permitted by the increase in the number of observations, but also in the method of charting, in which the aim has been to reproduce in a compact form, as clearly and fully as possible, all the original records, so that the navigator may recognize not only the average of the conditions of air and sea that he is to encounter, but the separate elements from which the averages are derived. Maury evidently perceived the importance of thus exhibiting observations as nearly as possible in their separate forms, instead of in the inaccurate generalizations of his predecessors; and this led him to the construction of the most realistic charts of the ocean that have ever been published. Not only the winds and currents were plotted in their place of observation, but the track and name of the vessel from whose log they were taken were mapped also. A small part of one of the North Atlantic wind and current charts is here reproduced in fig. 1, omitting certain details concerning the strength of the winds, as well as the colors by which the seasons were distinguished. The full, broken, and dotted lines indicate months within the seasons. Nothing could be better adapted to emphasizing the reality of the work in the mind of the average sea-captain; and the result of the ingenious device was soon apparent in the general interest ex-

¹ Ath. Kircheri, *Mundus subterraneus*. Edit. tert. Amstelod., 1678, i. 134.

² Discourse on the trade-winds, in his *Voyages*. London 1705.

cited among seamen in the study of the physical geography of the sea. It was a time of awakening to an opportunity of observation that had been too

frequency of rain and storms. In the further development of the study, the treatment of the Atlantic winds will receive our chief attention.

About 1855 a series of charts, based directly on Maury's Pilot charts, was prepared, under the direction of Admiral Fitzroy, for the London board of trade, on which the numerical form of record was replaced by graphic wind-roses for five-degree squares. These are known as the Board of trade wind-charts.¹ A little later Admiral Fitzroy published charts for the North Atlantic, showing winds, currents, temperatures, etc., for five-degree squares for February, May, August, and November. These were based on logs obtained from the records of the Board of trade, as well as on Maury's charts. In 1868 the hydrographic office of the British admiralty published its 'Pilot charts for the Atlantic Ocean,' giving Maury's results, combined with those from all other attainable sources, presenting the whole in simple, graphic form, but without precise indication of the original observations on which the averages were based. These are commonly quoted as giving the best general view yet published of the physical conditions of the Atlantic as a whole. Four large sheets show the winds for the four seasons, with the so-called 'limits of the trades' for every month; but insufficient attention

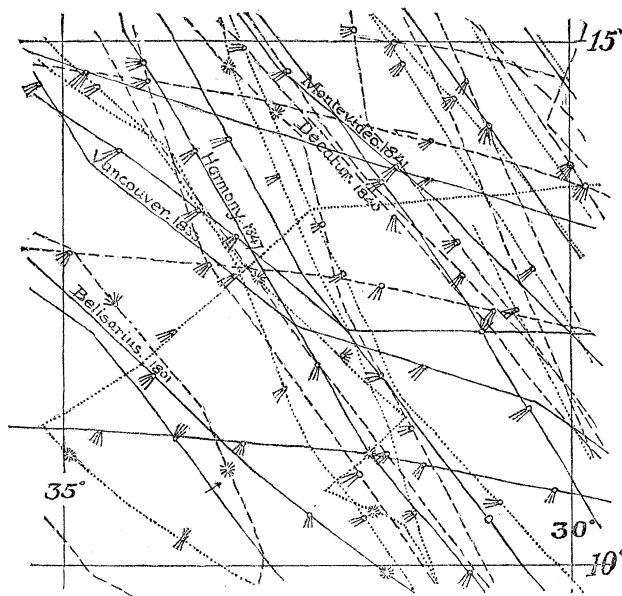


FIG. 1.

generally neglected before. But, in spite of their practical appearance, the Wind and current charts (or Track-charts, as they are commonly called) become unserviceable in the more frequented parts of the ocean, precisely where they are most needed, from the crowding together of observations. Along our coast and about the favorite longitudes for crossing the equator, the charts are unintelligible, except to the most painstaking examination, so completely are they covered over with a maze of signs and figures and a tangle of lines. This difficulty was overcome in the Pilot charts, on which the winds were singled out and counted for place and time; the style of record being shown in fig. 2. The numbers in the corners give the total number of wind-observations for each month in the given five-degree square; December, January, and February being in the northeast corner, and the others following in the order of hours on a clock-dial. The sixteen sectors of the circle include the number of times the wind was recorded for every month from the several compass-points to which they belong, the months being arranged as in the sector below the square. The centre contains the number of calms for every month in the same order as the total winds. The absence of graphic representation of the winds, and the confusion arising from the number of figures required to show the whole year's record on one sheet, were the chief disadvantages of these historic charts; but they were still vastly better than any thing of their time. Besides these, there were also prepared, about the same time, charts of the trade-winds and of the

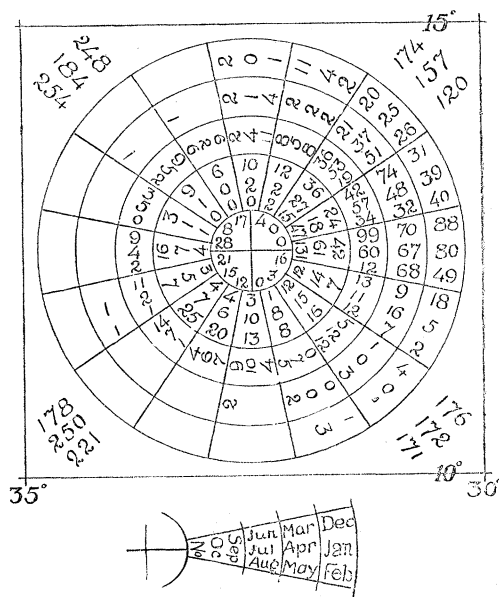


FIG. 2.

¹ Publications of the meteorological department of the London board of trade. Wind-charts of the North Atlantic and other oceans. See the account of these charts by R. H. Scott, *Quart. Journ. meteorol. soc.*, London, 1877, iii. 190.

was given to barometric and thermometric conditions. A fifth chart gives the average direction of the currents for the year.

Four years later (1872), these were given more extended form in the 'Wind and current charts for the Pacific, Atlantic, and Indian Oceans,' about on the same plan as before, but with the addition of isothermal and isobaric lines in small side charts, after the pattern of those prepared by Dove and Buchan. Part of the information in these charts was superseded, in 1872, by a volume giving monthly maps of 'Currents and surface-temperatures of the North Atlantic Ocean, from the equator to latitude 40° north,' prepared by R. Strachan, under the direction of R. H. Scott of the meteorological office. This is still the best work on North Atlantic currents and temperatures. The averages are here given for two-and-a-half-degree squares, from Maury's charts, Dutch observations, and some other sources, with the number of observations on which they are based. It is very evident from this, that the currents, especially, need a much more extended examination than they have yet received, especially when one recalls the irregular variations lately determined by Commander Bartlett in so marked a current as the Gulf Stream. If the currents have regularly periodic changes, as seems probable at certain places, the precise determination of their form will require a sifting of observations down even into one-degree squares.

The publications of the Dutch meteorological institute at Utrecht have long been famous. In addition to their extensions of part of Maury's charts in 1856,¹ a more independent set of monthly charts for the several oceans was issued a little later, on which a simple graphic method of showing direction and frequency of winds was adopted.²

Until recent years, comparatively little original work on the North Atlantic was done in France. The British pilot charts of 1868 were republished, changed only by translation of the names and explanations from English into French. In 1863, Ch. Ploix published his '*Vents et courants, routes générales*,' compiled from Maury's and other works. A revised edition of this was issued in 1874. Since then, Lieut. L. Brault, in charge of the meteorological service of the dépôt of charts and maps of the French marine, has undertaken extended studies of meteorology of the several oceans, based on twenty thousand selected logs ('*toute une montagne de papier*') of French vessels, dated between 1800 and 1870, and independent of the work of other nations. He states that the average accuracy of record is much

better than in the logs used by Maury.¹ His first series of charts gives the probable direction and intensity of the winds for every three months in the North and South Atlantic, Indian, and Pacific Oceans,²—sixteen sheets in all. In addition, a second series of monthly charts for the four oceans was to be prepared, showing winds, currents, rain, fog, cloudiness, squalls, storms, etc.; but these, I believe, are not yet completed. The accompanying cut (fig. 3) shows the graphic method of illustration used by Brault. The number in the middle is the number of observation for the square concerned. The radial bars show by their length the relative frequency of winds from the points of the compass to which they are directed. The different marking in these bars shows the relative frequency

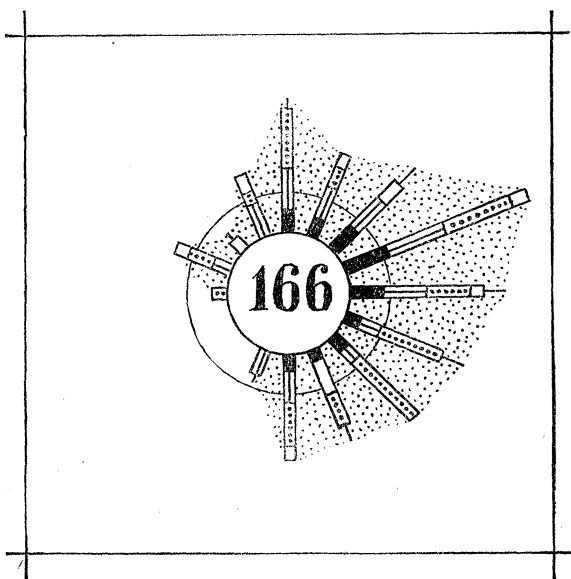


FIG. 3.

of five grades of strength, from heavy wind to light breeze. The ratio of the distance between the two concentric circles to the length of the longest arrow gives the percentage of calms. The detailed subdivision of winds according to their force is a special feature of this work. Brault notes that eighty observations in a five-degree square give trustworthy results for direction within the area of the trades; but three or four hundred are needed for the westerlies beyond the tropics. This statement is of value in enabling one to judge of the probable degree of precision in charts where the number of observations used in averaging is candidly given.

A valuable work, based on Portuguese and Dutch

¹ Maurij's wind-kaart voor het oostelijk gedeelte van den Noorder Atlantischen Oceaan, vermeerderd met hollandsche gegevens.

Maurij's passaat-kaart van den Atlantischen Oceaan, vermeerderd met hollandsche gegevens.

² 12 Windkaartjes van den Noorder Atlantischen Oceaan, etc. These were published in the *Uitkomsten van wetenschap en ervaring aangaande winden en zeestroomingen in sommige gedeelten van den oceaan*.

¹ *Étude sur la circulation atmosphérique dans l'Atlantique Nord pendant les saisons extrêmes*. Paris, 1879.

² *Cartes de la direction et de l'intensité probable des vents dans l'Atlantique Nord, pendant les mois de —; 1874. Id. dans l'Atlantique Sud; 1876. Id. dans la Mer des Indes; 1879. Id. dans l'Océan Pacifique; 1880.*

observations, covering a comparatively small but very interesting part of the ocean, is found in the account of the Gulf of Guinea by Lieut. Brito-Capello of the Portuguese navy.¹ The method of record here employed is easily understood, but does not give a measure of the number of observations used in averaging. Each fan is composed of arrows, showing the direc-

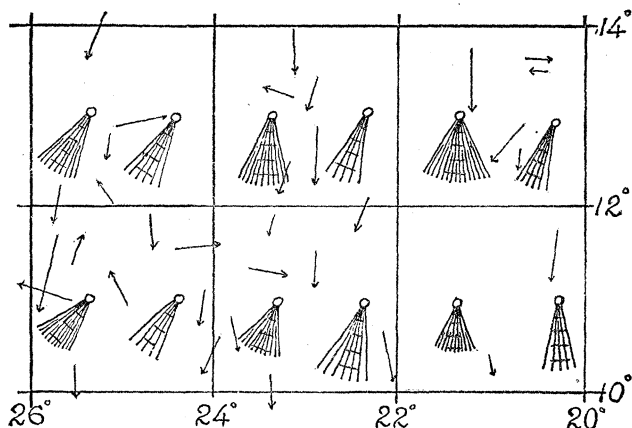


FIG. 4.

tion and velocity (estimated from distance made by sailing-vessels) of the local winds for a month. The angle of the fan measures the variability of the winds; and their length gives velocity, the distance between the cross-bars corresponding to the rather indefinite sailing-rate of 'one knot an hour close to the wind.' The apex of the fan is toward the source of the wind. The current-arrows show average direction, when the original observations accorded; but near the coast, where observations do not agree closely, averaging was not attempted. The length of the arrow is on a scale of one millimetre to two miles and four-tenths a day. Fig. 4 is from the chart for March and April; the fine-ribbed fans being for one month, the coarse-ribbed for the other.

Three admirable monographs of a certain number of the ten-degree squares (ten degrees of longitude by ten degrees of latitude) into which the ocean is divided for the convenient partition of observations, have been prepared under the direction of Capt. Henry Toynbee of the British meteorological office,² from logs of British vessels collected mostly between 1855 and 1870. The equatorial squares from north latitude 20° to south latitude 10°, between Africa

and South America, were first studied, as the doldrums of this region often cause vexatious delays to vessels crossing the line; and it is a problem of much importance to determine where the passage should be made. The group of squares about the Cape of Good Hope was next chosen as of difficult navigation, from their numerous gales and conflicting currents. These monographs are of the greatest value, not only to the seaman, but to the student as well; for they contain a large amount of information most carefully sorted out in time and place. Winds and isobars, temperature of air and water, currents, weather, clouds, etc., all have special record for ten subdivisions of every ten-degree square, and for every month. They are shown, first, in diagrams that summarize all available observations; and, second, most of these elements are given in charts of average monthly results. It is greatly to be hoped, both for practical and theoretical ends, that this excellent series of publications may be continued. Fig. 5 illustrates the concise method of detailed record of certain data for each of the ten subdivisions of the equatorial ten-degree squares. In the original, every thing relating to currents is printed in red.

The number of observations and mean force (Beaufort scale) of winds are given numerically, for every point of the compass from which they blow, on the two inner circles, and are further marked by arrows, whose length shows relative frequency, crossed by a curved line,

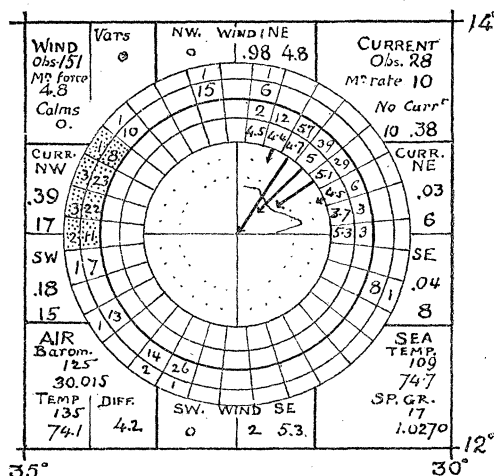


FIG. 5.

whose distance from the circumference shows force. Currents are plotted for the points of the compass toward which they flow in the two outer circles, the figures representing the number of observations and mean rate in miles per day. They are averaged for quadrants on either side of the circles; and an average of all currents is given in the upper right-hand corner of the square. Winds are similarly aver-

¹ Of this, I have only the French translation: *Guide pour l'usage des cartes des vents et des courants du Golfe de Guinée par M. de Brito-Capello*. Paris, 1862.

² Monthly charts of meteorological data for square 3; with remarks. London, 1874.

Monthly charts of meteorological data for the nine ten-degree squares of the Atlantic, which lie between 20° north and 10° south latitude, and extend from 10° to 40° west longitude; with remarks. London, 1876. (The results for square 3 are repeated in this second volume.)

Meteorological charts for the ocean district adjacent to the Cape of Good Hope; with a volume on the gales of that region. London, 1880.

aged at the top and bottom of the circles, and in the upper left-hand corner. The proportion of calms to winds is shown by the shading of a sector in the central circle (none noted in the square here copied). Number and average of barometer and air-thermometer observations are in the lower left-hand corner, with the average difference between dry and wet bulb thermometers. Temperature and specific gravity of the sea are similarly recorded on the right. The advantage of such record over final averages is at once apparent: it shows not only how well the various observations agree, but also the measure of trust to be placed in the results, as indicated by the number of observations. It is, of course, a little difficult to read at first, but, with a few days' practice, there is no further trouble. The charts for the Cape give less detail than those for the equatorial district, and their diagrams are of a much simpler pattern. Some of the more recent charts will be considered in a second article.

W. M. DAVIS.

THE INDUSTRIAL ARTS AS FACTORS IN MODERN HISTORY.¹

At the outset the lecturer suggested, as perhaps a more appropriate title for his remarks, 'Coal as a factor in modern history,' or 'Coal as the great reformer and revolutionizer.'

By reviewing past history, it would be noticed that certain great events had taken place, each of which marked a step in the advance of civilization. The connection between these events was not always apparent; but in fact they were interdependent, and formed a logical sequence, in many cases one directly or indirectly causing the next. The ancient Greeks were famed for their literary and aesthetic culture, in which they excelled all other peoples, ancient or modern. Their passionate temperament, however, and system of slavery, left unalaid the material foundations of permanent national prosperity. Again: the genius of the Romans had displayed itself in their military achievements; and, doubtless, Rome would have continued to be the mistress of the world, had it not been for the luxurious and profligate habits into which her people drifted, and through which she fell an easy prey to the barbarians. So monstrous were their excesses, that their punishment was inevitable and overwhelming. The excellence which those nations had attained had, no doubt, benefited succeeding generations.

The secret of true and permanent progress consisted in the application of science to the useful arts; and the development of this fundamental principle of progress had commenced only during more recent years. This was the power that had revolutionized social and political life. No one revolution had effected thorough and permanent changes. By the instrumentality of each, the light of liberty had shone for a brief interval, but the intolerance which was put down by it had been too often succeeded by equal

oppression on the part of those who had come into power. Yet each change had brought about a condition whereby the masses of the people had gained a greater or less advantage; and the power which each revolution had taken from the sovereign had been given to the people. These exchanges of power were more apparent in the history of England than of any country on the European continent. There the reign of every king had been despotic until the time of King John, when the Magna Charta was wrested from him, and thus was taken the first step towards the true liberty of the subject. Henry VIII., disregarding all laws, human and divine, had assumed as much despotism of action as was compatible with the then slowly advancing state of civilization. Elizabeth, too, was conspicuous for her assumption of unlimited power. Nor was Cromwell's power less supreme than that of the kings and queens before him. Then followed the court of Charles II., with all its splendor and vice. But soon after, when the house of Hanover flourished, a certain popular power began to undermine the autocracy of royalty. Then the Earl of Chatham, the elder Pitt, albeit with much individual pride and haughtiness, and with no special sympathy with democracy, became champion of the English people, and wielded a power which had never before been held by any subject of the crown. Pitt declared that he represented the people of England, and Wilke's resistance to the royal party again and again caused his election as a member of the House of Commons. The last attempt at despotic power, on the part of the reigning monarch, was the unjust taxation by George III. of England's American colonies. Since that time the power of the subject had been increasing in England, and at this day there was no country in which the rights of the individual were more fully recognized. The conservatism of the English nation had not permitted the dethronement of rank and title. This was, in the opinion of the lecturer, probably the result of inheritance, not choice. He said, moreover, that the distinction of rank held in check the power of money, and refinement and culture were thereby advanced; but, if the present monarch were to attempt to resume the despotism of some of her predecessors, a storm of revolution would sweep away monarch and throne and peers. For this changed and ameliorated condition of affairs, special credit was due to Sir Robert Peel, Cobden, John Bright, and Mr. Gladstone, the present premier. But the full triumph of democratic principles had not yet been fully realized in England, although it was rapidly approaching. It was worthy of note, that each Parliament introduced more liberal measures, and that the power of the House of Commons was fast superseding that of the House of Lords. England is now not only the home of freedom, but an asylum for the oppressed. Her shores are sought as places of refuge by fugitives of all kinds, who here found justice, and, if innocent, safety.

The moral and physical condition, too, of the present generation, is raised; and this age is conspicuous for its religious freedom, luxury, and the achieve-

¹ Abstract of a lecture delivered Saturday, April 19, in the U.S. national museum, Washington, D.C., by Prof. J. S. NEWBERRY of New York. Revised by the author.

ments of scientific investigation. We of this day scarcely realize that many things which are now considered necessities of life were absolutely unknown a hundred years ago. These changes have been wrought by the action of cause and effect. How interesting was the inquiry into the causes of this peaceful revolution that had been and still was going on! Some historians had ascribed the changes to certain inherent qualities in man, which must develop as time rolls along. Others referred this progressive state to the continued effects of the Reformation, and considered it as the fruit of a purer and broader religious faith. The lecturer admitted that the emancipation of the mind from narrow dogmas had had its elevating influence, but denied that this would entirely account for the present condition of civilization. Since this age of freedom is also an age of scepticism, he contended that the most potent cause of the eminence of England, and of the spread of democracy, was the production of wealth through the industrial arts, — wealth created and controlled by the untitled classes, who thereby acquire self-respect, self-assertion, and political power. All historians had recognized this truth in part, but had stopped short of the conclusions, which, to the speaker's mind, every unprejudiced man must reach. The development of machinery and the useful arts constituted the most distinctive feature in the aspect of our modern life. This had created cities, provided occupation for the people, and was the means which had supplied the majority of our material wants. And the agent of this development was *coal*.

This conclusion might, perhaps, appear to be a *reductio ad absurdum*, but he thought that the truth of the assertion could be demonstrated. Coal supplied us with light, heat, and motive power, without which our condition would be one of darkness and inactivity. The wheels of industry would be stopped, and the characteristic activities of modern life would be arrested. In a pound of coal was stored sufficient force to raise 11,580,000 pounds one foot; and it had been estimated, that, on an average, 1,500,000 foot-pounds were utilized in the combustion of a pound of coal. Supposing this amount to be equal to the force exerted by one man in a day's labor, then three hundred pounds of coal were equal to the force exerted by one man in a whole year: in other words, a ton of coal yielded a force equal to the labor of six men and a boy for a year; and the force exerted by the average amount of coal produced in England in a year would be equivalent to the labor of two hundred millions of men for the same period. A moment's reflection would convince us of the immense effect produced by this force upon our modern civilization. If, out of the amount of coal annually raised from the English mines, 20,000,000 tons represented the net profit, it would be seen that this profit was equivalent to the labor of 133,000,000 people, working ten hours a day for a year. Was it, then, surprising, that, with such a revenue, England should be the richest nation on the globe, or the most prolific? She had planted colonies in those parts of the earth which were richest in agricultural and mineral

resources; to wit, the United States, Canada, Australia, New Zealand, Cape of Good Hope, India, Jamaica, etc.: and these are fast becoming great nationalities. This marvellous success had by some been attributed to psychological rather than material causes; but the true cause, the speaker thought, was the development of machinery and the industrial arts consequent upon her abundant supply of coal. In the thirteenth century, when coal was first substituted for wood, and even a century later, its use was regarded as a nuisance, and actually forbidden by royal enactment, on account of the smoke which it evolved. Indeed, history told us that in 1257 Queen Anne, wife of Henry III., left Nottingham on account of the smoke caused by the burning of coal. By the middle of the sixteenth century, however, coal was in general use, and a considerable quantity was exported to France. In 1621 Dudley had devised a method whereby stone coal could be substituted for charcoal in the manufacture of iron. Then came gradually the introduction of steam-engines in place of horsepower, and iron rails instead of wooden ones, for the transportation of coal from the mines. The years 1702, 1776, 1815, and 1820 were conspicuous for improved changes in connection with steam-locomotion; and in the last-named year wrought-iron was substituted for cast-iron in the manufacture of rails. Fifty years ago Robert Stevenson perfected the locomotive, thus making the railroad the great pathway of traffic and travel. The lecturer then cited statistics which showed that the increase in the produce of iron and steel was proportional to the amount of coal produced. These were, he said, not only factors in the progress already noted, but were its proximate causes. It was worthy of note, that in those great English towns, such as Manchester, Liverpool, Leeds, and Newcastle, where coal was most largely used, the voice of the people was most powerful.

The lecturer then reviewed the possibilities for advancement in the United States, with its coal area of two hundred and fifty thousand square miles. He referred to the almost unlimited deposits of iron, copper, lead, and the precious metals, and to the vast wealth to be drawn from the soil by a thorough system of agriculture. Thus he argued that the United States possessed all the qualifications necessary to make it a greater and happier country than the world had ever seen. The great danger arising from these vast resources was the worship of the wealth they were destined to produce. The general accumulation of wealth by a nation was undoubtedly a blessing; but when held by the few, causing the impoverishment of the many, it could only be regarded as a curse. We might, however, hope, that when the evils of wealth-worship exceeded a certain limit, the people would again rise and correct them, as history teaches us they have done in the past. Among the influences which tended to restrict the effect of wealth on legislation, was the introduction of civil-service reform. The contest between labor and capital was far from adjustment; but the problem was under careful consideration, and in some instances had been practically wrought out to the satis-

faction of all immediately concerned, and to the instruction and guidance of others. The remedy for the excessive love of money would be found in the substitution of other and higher objects of ambition. This could not be expected at this stage of our nation's growth, but it would come with greater maturity. This age, he said, was the seed-time, and not the harvest; nor could the full corn appear until after the intermediate stages of the blade and ear.

THE PRESENT SUN-SPOT MAXIMUM.

AT p. 72 of the second volume of this journal, the observations of the solar spots, made during the previous six years by Professor Todd, now of Amherst college, were collated, and the inference drawn that the present maximum of spots had already passed at the middle of the year 1883. The remarkable solar outbursts, occurring at intervals throughout that year, and the continued manifestation of spot-activity during the present year, have led to renewed discussion of this subject abroad, where very different views are held by the leading authorities in solar physics. Dr. Wolf of Zurich inclines to the belief that we have not yet the data for determining accurately the epoch of maximum; much the highest *monthly* maximum having occurred in April, 1882, while the relative number expressing the spot-prevalence for the year 1883 is easily seen to be greater than that for the year previous. Faye thinks the maximum undoubtedly past, and regards the spottedness during 1883 as "just such secondary maxima as 'might well occur in the progress of a periodic phenomenon which passes rapidly and without hesitation from a minimum to the following maximum, but which passes gently by a series of secondary oscillations from the maximum to the following minimum,' as it is well known the solar spots do." Wolf states, that in 1882 there were no days without spots, while there were four such in 1883. Tacchini of Rome concludes, from the spot-observations of 1882 and 1883, that the solar activity has been on the increase during the latter year: "for, although the difference in the number of spots is very small, the number of groups in 1883 has been very much greater, and the extent of the spots has been truly extraordinary: it has been double that of 1882."

Dr. Spoerer of Potsdam calls attention to a question regarding the numbers, and positions on the solar surface, of the spots observed during the past thirty years. While it has long been recognized that the spots are most numerous, not at the solar equator, but in zones of solar latitude about 15° to 20° , Spoerer's discussion emphasizes the fact, "that, from the time of one minimum until the next, the region of greatest spot-frequency gradually drifts downward from the zone 30° to 25° , to the immediate neighborhood of the equator, and that about the time of maximum its seat lies about 17° or 18° . As the next minimum period is approached, spots more than 15° from the equator gradually become rarer than spots of 35° latitude and upwards were at the time of maximum. But

directly the time of minimum is past, spots begin to appear again in those higher latitudes where but very few, perhaps not a single one, had been seen for several years." As justly remarked by the editor of the *Observatory*, this law of sudden transfer of spot-activity from one zone to another is one of the most striking revelations of solar research, and must be accounted for by that theory of spot-periodicity which would be accepted as satisfactory.

Regarding the determination of the present spot-maximum, the same writer observes, that the chief difficulty lies in a variety of opinion regarding what class of data is to be accepted as affording the true index of the state of solar activity. The unusual magnetic perturbations have occurred in coincidence with "the appearance or rapid development of some single spot or group of spots of abnormal extent," and not at the same time with the existence of great numbers of small spots. It would appear, thus, most likely that the total spot-area, rather than spot-numbers, should be taken as the true index.

GUYOT'S VIEW OF CREATION.

Creation; or the biblical cosmogony in the light of modern science. By ARNOLD GUYOT, LL.D. New York, Scribner's Sons, 1884. 16+139 p., 9 pl. 16° .

THE great eminence of Professor Guyot in several departments of science is a guaranty that what he writes is worthy of attention. The singular simplicity and clearness of his style make what he writes interesting. But, more than all, the earnestness, the truth-loving sincerity, and deep devoutness of the man, in all he wrote, or said, or did, take captive the reader, or hearer, or companion, and bear him along by the force of sympathy. There has been no teacher in this country who has inspired his classes with deeper personal love, or profounder reverence. To us who knew him well, his very presence was a benediction. It is hardly necessary to say, therefore, how deeply and sincerely we sympathize with the devout spirit which pervades this his latest book, and the noble aim of the author in publishing it. Surely, if we must have reconciliations of this kind between the geological record and the Mosaic cosmogony, this one is the noblest and the most rational which we have yet seen. If any one's declining faith still requires such *tonic*, we most cordially recommend this one; but it has long seemed to us that a *complete change of air* is the better, indeed the only, remedy. We believe that the time is rapidly approaching, if it has not already come, when the whole subject must be looked upon from a different and higher point of view. We have ourselves, in earlier years,

undertaken to make such schemes of reconciliation, and that which we finally and somewhat laboriously constructed was very similar to that of Professor Guyot. But latterly we have thrown all such aside, as belittling a transcendently great and serious subject. But for those who think differently, we give a very brief account of the book, with some reflections thereon.

Professor Guyot's scheme differs from many others in the fact that his first two days are wholly cosmic, and not terrestrial. First comes, of course, the creation of matter, its chaotic or nebulous condition, and the energizing of it by the brooding spirit. This is preparatory. Then, as the first day's work, is the creation of light. This, according to Guyot, was the condensation of the nebulous mass by gravity, and the consequent development of heat and light. The second day's work is the creation of the firmament, or *expanse*. The expanse here spoken of is the interplanetary space. This day, therefore, corresponds to the formation and separation of the planets (the earth among the number) from the still nebulous sun. The scene is now transferred to the earth, and the correspondence is henceforward with the geological record. The third day's work was the separation of land and water (by unequal contraction of the earth), and the creation of plants; at first, according to our author, only of the lowest kinds (protophytes). This corresponds to the early archæan. The fourth day's work was the placing in the heavens of sun, moon, and stars, for marking of days and nights, and times and seasons. This, according to our author, was the *first appearance* of the heavenly bodies by the clearing of the sky, heretofore completely obscured by clouds of vapor. This was a necessary preparation for animals and higher plants. It corresponds to later archæan. The work of the fifth day was the creation of animals (and our author thinks many higher plants also), monsters of the deep, creeping things, and fowl of the air. This corresponds to the whole paleozoic and mesozoic. The work of the sixth day was, first, the creation of four-footed beasts (mammals), and afterwards of man. This corresponds to the cenozoic or tertiary, and quaternary. The seventh day was rest, — no creative work, no new continents, no new organic forms. This corresponds to the psychozoic, or present. Throughout, of course, the days are regarded as cosmogonic, not solar days.

Such is a very brief sketch of the scheme. Those who wish to understand it more fully,

and especially to see the skilful way in which the details are worked out, must read the book.

A few words now in the way of reflection and criticism. Professor Guyot draws special attention to the fact, that the word *bara* ('create') is used in connection with only three events; viz., the creation of matter, of sentient life (animals), and of spirit (man). In connection with other events, another word is used. He makes much of this in connection with the apparent chasm which exists between inorganic forces and life, and between the sentient soul (*anima*) of animals and the self-conscious spirit of man. Certainly there are great gaps at these points; but surely science would place the second one, not between plants and animals, but between plants and minerals. The *bara*, therefore, should come, not on the fifth day, but on the third.

Again: Professor Guyot assumes that life is an immaterial principle, not correlated with the other forces of nature as these are with each other, and connects this with the apparent impossibility of abiogenesis, or origin of life by inorganic forces; and this, again, with the necessity, as he thinks, of a rupture of the continuity of nature, and of a supernatural interference at the time of introduction of life on the surface of the earth. Now, as to the first point: we think that nearly all scientific men believe that life-force is derivable, and in fact is always derived, from physical and chemical forces, under appropriate conditions. One of these necessary conditions seems *now* to be the *previous existence* at the very place and time of *living* matter. Abiogenesis seems *now* to be impossible. Life is a necessary condition of derivation of life-force, but none the less is it derived from lower forces by transmutation.

This brings us to the second point. Most persons, even many scientific men, seem to think that the truth of the doctrine of evolution is conditioned on the occurrence, or at least the possibility, *now*, in this geological epoch, of abiogenesis. We do not think so: on the contrary, we think that the impossibility of abiogenesis *now* is exactly what a clear conception of the law of evolution would lead us to expect. The mistake which leads some to imagine that abiogenesis is a necessary corollary of evolution is of the same kind as that which leads some persons to imagine that evolution implies the capability of any one of the lower animals to develop into man. Golden opportunities in evolution occur *but once*. Birds, doubtless, came from reptiles; but this is not going on now. Reptiles came through amphibians from fishes, but a salmon may not

hope ever to change into a lizard. One of the greatest steps in evolution was the origin of life, but it is unreasonable to suppose that the concurrence of favorable conditions necessary for this step could occur only once in the history of the earth. The impossibility of abiogenesis *now* is, therefore, no argument against an abiogenesis once in the early history of the earth.

Again: the author, while he admits that evolution is not necessarily destructive of the idea of a guiding intelligence in nature, while he insists on the necessity of supernatural interference only at the three points mentioned above, thus implying that evolution may possibly take charge of the process in the intervening time, yet plainly inclines strongly to the supernatural origin of species. Along with many other deeply religious minds, he seems to shrink from the cordial recognition of the law of evolution as if it dispensed with the necessity of a God in nature. But surely this is no more true of evolution than of any other law of nature. If the law of gravitation did not destroy our belief in a divine sustainer of the cosmos, why should the law of evolution destroy our belief in a divine Creator? If the law of gravitation be nought else than the divine method of sustentation, then is the law of evolution naught else than the divine process of creation.

One thing more: the present epoch is supposed by the author to differ from all previous ones in the fact of *rest from creative work*. We cannot allow that this is the decision of science. The very possibility of a science of geology is conditioned on the continuance of geological changes, i.e., of creative work, under our eyes.

In conclusion, we must say, that, given the point of view, the frame of mind of the author, — a frame of mind still the most common among religious men, — the book is undoubtedly deserving of much praise as the very best of its kind. But we feel sure that the frame of mind of the religious world is on the eve of change, and, with the change, the '*raison d'être*' of the book will no longer exist.

TRYON'S CONCHOLOGY.

Structural and systematic conchology (etc.). By GEORGE W. TRYON, jun. Vol. iii. Philadelphia, *The author*, 1884. 453 p., 49 pl. 8°.

THE final volume of Mr. Tryon's work has appeared, including over four hundred and fifty pages of text and about fifty plates. It treats of the pulmonate gastropods, the Scaphopoda

or Dentalia, the lamellibranchs, and the brachiopods, and contains an appendix with numerous additions and rectifications and an index of genera comprising nearly sixty-five hundred different names. We have previously referred to what we consider the defects of the plan and of some of the details of the earlier volumes, — defects which this one shares to a certain extent. Nevertheless, as it is in large part a treatise on groups which the author has made the subject of special study, he has made it by far the best of the three, — a fact which it gives us pleasure to recognize. In spite of the criticism which the work as a whole has seemed to us to call for, it is only fair to the author to point out the immense labor required to bring together the material condensed in the two descriptive volumes, and the service which this condensation, in spite of certain defects, will render to workers in conchology and paleontology. The devotion with which the author has applied himself to the study of mollusks for years, has not been fruitless; and here and there in the text most students will find scattered opinions and remarks which will recommend themselves as sound and judicious. While the character of the illustrations cannot be said to be satisfactory, yet they are in most cases sufficiently recognizable to be of service to him who knows what he seeks. If we fail to find in the systematic arrangement that grasp of the subject which might be wished for, and that exposition of recently developed truths one naturally seeks in the newest book, yet we recognize the benefit the author has conferred on specialists, at the cost of an enormous amount of drudgery, by bringing into reasonable orderliness, from innumerable scattered sources, the names and descriptions of thousands of generic forms. For this the work will be welcome in many libraries.

STEAM-ENGINE INDICATORS.

The Tabor steam-engine indicator. By GEORGE H. BARRUS, S.B. New York, 1884. 75 p. 24°.

THE preface of this little handbook states that it was prepared at the solicitation of the Ashcroft manufacturing company, makers of the Tabor indicator, as a book of reference and instruction to purchasers and others.

The subject of principal interest in the book is, of course, that of the construction and performance of the Tabor indicator, especially as compared with other indicators; although there is, besides this, a variety of useful matter, tables, etc.

With regard to this principal object of the book, we must confess to a little disappointment; for, since its author is an acknowledged expert in steam-engineering, we should naturally have expected him to institute experimental comparisons between this instrument and whatever other indicator is regarded as the best in market.

The improved form of the Thomson indicator, made by the American steam-gauge company, we believe to be in high favor with the profession. Mr. Barrus may, for aught we know, have compared the Tabor indicator with this or some other good modern indicator; but the only comparisons here published are with older instruments. The special mechanical advantage claimed for the Tabor indicator is the greater lightness of its moving parts. The pencil-arm (which has the highest velocity) is substantially the same in this and other instruments, and the reduction of weight is in parts having a less velocity. Still there is, we think, substantial truth in the claim of lightness. It would seem that any of these instruments might use aluminium to advantage to save weight in the moving parts.

From a curious little loop which is found just at the beginning of the stroke, after the admission-valve is opened, and which is not seen in the Richards and Thomson cards taken at the same time, we suspect that possibly the pencil lags behind its true position in other parts of the diagram, as it certainly must in some part of the loop, and that there are consequently unknown distortions of the card.

While great efforts have been put forth to make the parts carried by the spring light, and to give the spring as much firmness as possible, because its vibrations show with great distinctness upon the card, it does not appear that equal care and ingenuity have been expended to secure a positive to-and-fro motion of the card, which shall exactly correspond to the stroke of the piston. The exactness of this correspondence is of the first importance, but all errors of this nature are so masked in the indicator card as almost to defy detection. Since the typical steam-engine of to-day runs at a very high speed, and the indicator in its present form is essentially a low-speed instrument, the results which it gives are, to say the least, liable to uncertainties. For example: at speeds of six hundred to eight hundred revolutions per minute, the Tabor cards show vibrations which are probably as large as those in the Richards and Thomson at three hundred or four hundred revolutions per minute; and it appears as though no improvements could make any

indicator of such a form work well at the highest speeds.

It seems possible, however, that a recent improvement in a new direction, made by Prof. J. Burkitt Webb of Cornell university, may overcome this difficulty; ¹ and, as any improvement in instruments of precision is of importance to science, we may here briefly explain its nature. Were a pin so placed as to block the piston of the indicator just as it reached its highest point, it is obvious that the vibrations which then usually appear would be stopped; and, were another pin so placed that the piston could return only a small fraction of the whole distance to the zero line, then the pencil would describe only that part of the diagram between two lines near together, and parallel to the zero line. If during the next stroke these stops be moved one step nearer the zero line, the pencil will then describe another part of the diagram; and the process may go on until the diagram is completed. Since vibration is completely destroyed by this device, Professor Webb is enabled to use long and flexible springs, instead of the short, thick ones now in vogue, and so discard the parallel motion entirely.

RECENT WORKS ON THE MICRO-CHEMISTRY OF PLANTS.

Vegetable histology. By D. P. PENHALLOW. Boston, Cassino, 1882. 40 p. 8°.

Botanical micro-chemistry: an introduction to the study of vegetable histology. By V. A. POULSEN. Translated with the assistance of the author, and considerably enlarged, by WILLIAM TRELEASE. Boston, Cassino, 1884. 118 p. 8°.

Hilfsbuch zur ausführung mikroskopischer untersuchungen im botanischen laboratorum. Von WILHELM BEHRENS. Braunschweig, Schwetschke, 1883. 398 p., 127 figs. 8°.

A TRANSLATION of Schacht's little treatise on the microscope as applied to vegetable physiology, now out of date and out of print, has long been the only handy book in English, available to our students of histology who are unfamiliar with French and German. To be sure, all the better works on microscopic manipulation devote a few well-considered pages to directions for the manipulation of vegetable sections and to the principal reagents. But a convenient special work has long been felt to be a desideratum, especially in this country, where the exchange of microscopic specimens, and the interchange of hints by systematized correspondence, have never received the full

¹ See figure and brief description in the *Trans. Amer. soc. mech. eng.*, 1883, reprinted in *Cotton, wool, and iron*, Feb. 2, 1884.

development which the utility of the exchange system warrants. Partly to meet this want of a handy guide for his own students, Professor Penhallow, now of McGill college, Montreal, prepared a work under the somewhat misleading title, 'Vegetable histology.' This little treatise deals only indirectly with histology. Its real design is to furnish a student, whether working alone or under guidance, with suggestions as to the use of the principal media in which to examine objects, the reagents for detecting the more common contents of cells and for recognizing the chief modifications which the cell-wall undergoes. In this it succeeds. The directions are clear, and sufficiently full to satisfy any beginner.

To meet the same demand among students in his own country, Poulsen of Denmark has published a handbook, which has been received with marked favor. The translations into German and French are widely known as useful laboratory guides. The recent translation into English, by Professor Trelease, has been neatly and carefully done, and embodies various suggestions by the translator, most of which are improvements. The work treats first of the reagents, their preparation, impurities, and employment. To this part is added a useful chapter on the media for mounting, and the safest cements. The directions for using the newer staining-agents are not always so explicit as to leave no room for further questions on the part of the student who is working by himself, but they are full enough to indicate the wide applicability of this group of chemicals. It is interesting to note how important a part staining-processes — which, within the memory of some of us, were wholly relegated to amateurs who desired to make pretty specimens for the sake of exhibiting their skill in manipulation — now play in the most recondite researches as to the behavior of the nucleus, and the growth of the cell-wall. It is doubtful whether these methods are not capable of much wider development.

Part second of Poulsen's book is devoted to the examination of vegetable substances. The

author has included in his work upon this, some substances which might as well have been left out as some which do not find a place; but, as will be seen by a glance at the comprehensive treatises of Ebermeyer and of Husemann and Hilger, the task of selection is not an easy one. Professor Trelease has placed American teachers under obligations by the excellent translation which he has given them.

With a much wider scope, but covering within its range the materials made use of both by Penhallow and by Poulsen, Behrens's work upon the microscope and its use in laboratories of vegetable physiology, is a welcome addition to botanical literature. It is rather fussy in some of its particularities, but even this extreme of minuteness will be useful to many people into whose hands it is likely to fall. The *naïve* honesty of the author is well shown in some of the striking cuts: for instance, a couple of finished slides are delineated with cover-glass and cement and labels all in place; but the cement, instead of being laid on as evenly as an engraver would naturally depict it, has been represented with a charming and comforting irregularity which will be sure to be followed. In this work Behrens has given exhaustive details as to the selection and employment of all the appliances required in the histological laboratory, and has, for the most part, expressed his critical views with clearness and decision. The references to the literature of the subject are very copious. It is to be earnestly hoped that the announcement is true that the book is soon to be translated into English by a competent person, who has evinced much enthusiasm in microscopical matters. In such a translation it might be well to incorporate a part of the material which was intrusted to the more ephemeral microscopical journals, and which, useful at the time, is in danger of being lost. And such a translation would, doubtless, give less prominence to a few of the excerpts which Behrens himself has made from such journals.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

Work in West Virginia. — The wisdom of the general government in lending its aid to the development of the wealth and natural resources of the

country is nowhere, perhaps, better illustrated than in the work being carried on by the survey in that portion of the Alleghany coal-field that lies between the Great Kanawha and Chattarawha (or Big Sandy) Rivers in West Virginia. Topographical work in this section has been in charge of Mr. W. A. Shumway.

The necessity of preliminary topographical work needs no proof; for it is a self-evident proposition, that without the aid of correct maps, defining the mountains and ridges within which are embraced the main geological features of the country, the geologist, however well versed he may be, is likely to be led into error. The more complicated the geological structure, the greater the degree of accuracy required in the geographical work.

A glance at any of the existing maps of the United States will show that this southern part of West Virginia is about as destitute of railroad communication as any other district of the same area east of the Mississippi River, if not more so.

The peculiar topography of the Appalachians caused engineers to look suspiciously on attempts to cross its ridges at right angles to the axes of uplift, and for a long time retarded the development of this region. Thus unprovided with transportation facilities, the country itself was naturally but sparsely populated, and of itself unable to construct the means of communication with the great tides of commerce passing to the north and south. Another factor retarding the development of the region has its origin in the vexatious litigations concerning titles and the ownership of West-Virginia lands, which are due largely to the indefiniteness of former survey-lines, run independently and without connection with each other. This state of affairs will, in large part, be remedied by the work of the geological survey.

The completion of the Baltimore and Ohio, and the Chesapeake and Ohio railroads demonstrated the possibility of practical and feasible routes through the supposed barrier of the Alleghanies, and has partially developed one of the most valuable coal areas within the limits of the United States. It now remains to construct lateral branches, and to make a comprehensive and detailed geological investigation of what promises to be one of the most interesting mining and manufacturing regions of the country. Mr. Shumway, in 1883, surveyed between four thousand and five thousand square miles of this section, comprising the counties of Wayne, Boone, Logan, Wyoming, Mercer, Raleigh, Lincoln, and portions of Cabell, Fayette, Kanawha, and Summers. The office of the completed map is to supply the geodetic features for the establishment of the true position of the geological formations, and to serve as a basis for a subsequent elaborate and exhaustive geological study of the included region. Like all the older states settled previous to the adoption by the government of the present rectilinear surveys, West Virginia has been forced to rely, for her geological mapping, upon such field-work as very meagre state appropriations allowed. The work accomplished was consequently of a very fugitive nature; and, because of the absence of any connected system of land-surveys over the state, the existing published maps have no claim to faithfulness in the delineation of the geographical features of the country, much less to accuracy in the portrayal of the surface configuration.

It is true that innumerable land-traverses cross and recross the country in a perfect network of lines,

some being run with more or less respectful regard to nature, but the greater number being surveyed by engineers solely in the interests of the land-owners. In the few instances which have a plausible claim to accuracy, the variations of the magnetic meridian, differing by no inconsiderable amount in contiguous tracts of land, and resulting often from the presence of iron oxide beneath the surface, precludes the possibility of accepting these disjointed meanders as furnishing reliable and correct geographical data for use as a basis for scientific work.

The difficulties met with in mapping the area under consideration are those common to the work in the southern Appalachian Mountains, where dense forests, and the absence of a sufficient number of commanding points well situated for triangulation stations, offer obstacles to the topographer which make the most constant demand on his experience and judgment, and, at the same time, call for the most extravagant outlay from his stock of patience and good nature. It is doubtful if, within the limits of the United States, there exists another section of country in geological structure so simple, yet for topographical work so replete with obstacles and difficulties, as this coal-region of West Virginia. It is simply bestowing credit where it rightfully belongs, to state that the forthcoming map is mainly the result of the experience and able judgment, in geographical work, of Mr. Henry Gannett, the chief geographer of the survey, who supervised the work in this area.

The character of the topography here, as in all regions, is derived from, and varies with, the nature of the geologic formations. The most casual study of the stratigraphy of the district evidences the fact that the entire country, now underlain by the coal-formation, at one time constituted a vast basin or geosynclinal. After a long period of oscillations, producing a series of emergences and submergences, during which the succession of coal-beds and interstratified sands, clays, etc., were formed, at or near the close of paleozoic time, there occurred an epoch of disturbance which resulted in the general elevation of the Appalachian region, and produced the numerous ridges, faults, and displacements of the Alleghanies. As might naturally be inferred, the greater the distance from the centre of disturbance, the less prominent were the effects, until reaching the axial line of the Flat-Top and White-Oak Mountains. We find that from here, westward to the Ohio River, the entire country seems to have been elevated in one mass, hinging on that river, and having a gradual slope to the north-west, which is the direction of the prevailing dip. The development of faults relieved in a large measure the strata lying to the westward; and the presence of the massive sandstone in the conglomerate series, also, no doubt, aided in preventing the flexures extending to the west.

This region may therefore be regarded as an eroded plateau, sloping from the east toward the Ohio: so that, to the west of the axial line just referred to, the rocks dip faster than the plane of erosion, and we pass necessarily into higher and higher strata of the coal-formation; that is, the highest strata in geo-

logical position occupy the lowest place geographically. The general plane of the country is determined by the upper surface of the conglomerate series, which continues to rise from the west, until, in the mountains already mentioned, it attains an elevation ranging between thirty-two hundred and thirty-five hundred feet. The Raleigh plateau-region owes its existence to the presence of the conglomerate series.

The comparatively incoherent strata of the carboniferous above the conglomerate sandstones were quickly eroded away. When the upper surface of the hard conglomerates was reached, the degradation of the surface in a measure ceased, and the mechanical action of the streams was concentrated in deepening and widening their channels. This has produced the cañon-like features so characteristic of the New-River district.

The lateral wear in most cases was necessarily slight. The marshes of Coal River form, however, a singular exception to the general topographical features; as in this case the erosion, acting laterally, has resulted in a deep and rather broad valley. The conglomerate series, with its slope to the north-west, passes beneath the lower coal-measures near the embouchure of Gauley River, which, in turn, sink beneath the water-level a short distance west of Charlestown. The lower barrens, which overlie them still farther west, pass beneath the upper coal-measures.

The cañon-like features of the valleys are gradually lost as we go westward from the Kanawha Falls; and the hills become lower and lower, until, when the Ohio is reached, they do not rise more than two hundred feet above the river.

With the exception of the gradual difference in elevation due to the general rise in the country from the Ohio eastward, the surrounding knobs appear on one and the same level, and offer the most indisputable evidence of the plateau nature of the entire country; the mountains being simply the uneroded remnants of higher strata, resting on the basal plane of the conglomerate series.

It is this character of the country, in which there are few salient points well located for suitable sta-

tions for instrumental work, that retards topographical work, and renders impracticable the application of methods that are elsewhere best adapted to effect the most economic and accurate results.

The primary triangulation extending over this section connects at the north and south with the triangulation work of the U. S. coast and geodetic survey, while the lines of the secondary work establish geographical positions throughout the entire area included between the Kanawha and Chattarawha Rivers. With these numerous geodetically determined positions, it was found possible, by judicious adjustment, to utilize a large amount of existing material, sufficiently accurate in point of drainage detail, but heretofore valueless as a means of absolute location.

The completed map, as prepared for publication, will be upon a scale of 1: 250,000, or approximately four miles to one inch, in approximate contour lines having a vertical interval of two hundred feet. When draughted, and made continuous with the government surveys extending throughout the whole southern Appalachian region, it will serve as a basis for subsequent geologic investigation in the field.

The field of work included in these surveys has long since been recognized as a most important one; and nowhere more than in the coal-measures of West Virginia is there a greater need for most concise and accurate geological and geographical knowledge, for nowhere can be found circumstances so favorable for the advantageous employment of capital.

Geological survey of Canada.

New-Brunswick division. — Work in this province will be resumed in May, under the direction of Prof. L. W. Bailey, and will be carried on in portions of Carleton and Victoria counties with a view to the preparation of an additional sheet of the general geological map of the province, of which about eight sheets have been already issued. A series of observations on the superficial geology will be simultaneously but independently undertaken by Mr. R. Chalmers.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston society of natural history.

May 7. — Mr. F. W. Putnam spoke of an interesting find by Dr. C. C. Abbott, who has made such important discoveries in the Trenton gravels of the Delaware-river valley, and who was the first to prove that man existed on the eastern coast of America at the time a large part of the country was covered with ice, or during the glacial period. The recent discovery was that of a portion of the right side of a human under jaw, which was found sixteen feet below the surface, in the gravel at the railroad cut near the Trenton (New Jersey) depot. In this same deposit, and a few feet above the jaw, Dr. Abbott had

previously found a human tooth, and many stone implements of a rude type. The fragment of human jaw was exhibited, and is shown to be worn and ground in the same way as the pebbles above and about it. Mr. Putnam was on the spot a few days after the jaw had been discovered (on April 18) by Dr. Abbott, and identified the gravel and sand matrix in which the jaw is enclosed, with the material in place. Near and in the gravel above this jaw was found, a few years since, the tusk of a mastodon.

Anthropological society, Washington.

May 6. — Mr. O. Dorsey gave a classification of the Siouan tribes, including the Sioux proper, Assine-

boin, Ponka, Omaha, Osages, Kansas, Kwapas, Iowas, Otos, Missouriis, Winnebagoes, Mandans, Minnetarees, Crows, and Tulets. The general impression seems to have been, that this stock moved from the north-west. Mr. Dorsey took an opposing view, and traced the tribes from the south-east, up the streams, and from the region of the lakes westward. — President Gallaudet said that there were in existence in Europe several societies whose object is to discuss the subject of international relations. The speaker took the ground that the proper basis of these relations should be ethical rather than legal. The law term for *jus gentium* was objected to, and the phrase, 'international rights,' or 'international ethics,' suggested. While nations would not listen to absolute commands of law, they have ever shown some willingness to listen to ethical arguments, on the justification of their foulest acts, by appealing to the verdict of humanity as to the justice of their cause. If publicists should insist that no acts of nations should be justified that are not right between individuals, the subject of international law would be settled on a firm basis, and Mirabeau's words, 'Le droit est le souverain du monde,' would become a fact. The paper was discussed by Major Powell, who took issue with the speaker on some of his means, agreeing with him in the desirability of the end to be attained.

Engineers' club, Philadelphia.

May 3.—Mr. S. N. Stewart exhibited a model of his river or current motor. Paddles are placed upon cranks, and maintained in a vertical position, by long, floating vanes or tails. The cranks are placed upon posts, rafts, or boats in the stream, and journalled at the water-line, thus keeping one-half of the paddle-surface in action, while the common floating-wheel, or current-wheel, only keeps one-tenth of its surface in action. In Mr. Stewart's motor, a ten-foot arm carries a paddle ten feet high. — Mr. Thomas M. Cleemann read a paper on an economical form of bridge-truss. In outline, it resembles Whipple's arch-truss, inverted so as to bring the curved portion in tension, but differing from it in having the chord made to resist tension, and being anchored to the abutments. In this way, the only parts of the bridge in compression are the vertical posts, and the extra material required to stiffen the upper chord in an ordinary bridge is saved. To illustrate the correctness of his conclusions, Mr. Cleemann had a small model made of pink wrapping-twine, that broke with five and a half pounds, and with posts made of wooden knitting-needles. This model, by calculation, ought to have borne about eleven pounds. After loading it with a pound weight at each of the seven panel points, and letting it remain for a little time for the inspection of the members, he added, first, two more pounds at the centre, and afterwards two pounds more. With this eleven pounds, the model hesitated a moment, and then broke at each abutment, nicely illustrating the author's conclusions. He likewise gave the saving of material in such a bridge over a Pratt truss, of five

hundred and sixteen feet span, and pointed out its advantages for military purposes, where facility of transportation is a prime object, and a bridge almost entirely of rope is especially valuable on this account.

— The secretary exhibited for Mr. J. H. Harden a neat topographical model of the Jones iron-ore mine in Berks county, Penn., and briefly explained the method by which such models are constructed.

Numismatic and antiquarian society, Philadelphia.

May. 1. — Mr. E. F. im Thurn of Demerara presented valuable works by himself, relative to the ethnology, geography, and fauna and flora, of British Guiana. — A letter was read from Rev. Damaro Sota, mayor of San Sebastian, Concordia, state of Sinaloa, Mexico, in reference to his late discovery of the key to the Mexican hieratic writing, stating that he was preparing a work setting forth his views and the exact nature of his discovery. — Dr. C. C. Abbott of Trenton read a paper on the existence of an early race in the valley of the Delaware, whose relics were found by him in the Trenton gravels, and adverted to a fragment of a human skull being found there by him on April 18, 1884, in connection with the palaeocystic implements. At the conclusion of his address, he presented the society with a quantity of these hitherto debatable implements, which were plainly productions of the hand of man.

Academy of natural sciences, Philadelphia.

April 22. — Dr. Joseph Leidy directed attention to some fossils, part of a collection recently referred to him by the Smithsonian institution for examination. They consist, for the most part, of remains of large terrestrial mammals, especially related to forms which now live in the intertropical portions of the old world. Obtained in Florida, they are of additional interest as evidences of the existence, in this region, of a formation of tertiary age not previously known. An accompanying letter from Dr. J. C. Neal of Archer, Fla., states that the fossils were discovered in a bed of clay occupying a ridge in the pine-forest. They occurred over an irregular area of a hundred feet long by thirty feet wide, and were dug from variable depths of seven feet to the bed-rock, the character of which is not stated. The fossils, consisting of bones and a few teeth, are mostly in fragments, but exhibit no appearance of being water-worn, or abraded by friction among gravel. The collection embraces the remains of a young mastodon, consisting of bone fragments and detached epiphyses, with a vertebra of a teleost fish embedded in the clay adherent to the under surface of the head of a femur; the remains of several individuals of a species of rhinoceros rather smaller than, although quite as robust as, the Indian form; small fragments of the maxillae of a tapir; the remains of a llama as large as the camel; a calcaneum of a ruminant, not quite so long as that of the Irish elk, but of more robust proportions; the vertebral centrum of a small crocodile; and the remains of several other undetermined animals. The fragments were not sufficiently charac-

teristic to permit of their being placed specifically. The formation represented belongs to the pliocene or later miocene, although its exact position is somewhat uncertain. The tapir had been found in several states; and the mastodon was, of course, widely distributed; but neither the rhinoceros nor the camel-like remains represented in the collection had before been found east of the Mississippi. Professor Heilprin regarded the discovery of importance as lending decided support to Professor Hilgard's views regarding the former distribution of land in the region of the Gulf of Mexico, and the probable connection of Florida with Mexico. Similar fossils had, he believed, been found in the Mexican plains. The bed-rock near Archer, Fla., belongs to the oligocene formation. — Mr. Joseph Willcox announced that he had again found in Florida, specimens of Nummulites Willcoxi Heil., which had been regarded as of so much interest when collected by him a year ago. The examples now submitted for inspection had been obtained about fifteen miles north-east of the original locality on Cheeshowiska River, and about a hundred and fifty feet above the sea. Professor Heilprin commented on the importance of the discovery of the more elevated region just reported as indicating where the nummulitic formation could actually be seen. The other specimens were collected not more than two feet above tide-water, and were not, therefore, absolutely indicative of the position of the parent rock. From association with the Orbitolites, we can state that the beds belong to the upper oligocene age. The genera Nummulina, Orbitoides, Heterostegina, Quinqueloculina, Triloculina, and perhaps Biloculina, together with Spirorbulina, were represented in the masses of rock received from Mr. Willcox. The remains of fresh-water mollusks were associated with them, specimens of microscopic Paludina having been determined. This association of fresh-water with marine organisms might indicate the former emptying of a river into the sea, or the presence of fresh-water swamps in ancient Florida. The elevation of the locality whence the fossils were obtained need not be regarded as complicating the problem; for it must be remembered that this in no way represents the original height of the formations.

Philosophical society, Washington.

March 29. — Dr. J. S. Billings spoke of the uncertainty of measurements of cranial capacity. The best results, without the division of the skull, are obtained by means of shot, which is poured in, and afterwards measured; but even these are poor. The same observer does not obtain closely approximate results from successive measurements of the same skull, and different observers obtain widely different results. He then exhibited a series of composite photographs of skulls, each photograph being derived from a series of adult male skulls of one race. In the formation of each negative, the plate was exposed successively to from seven to eighteen skulls. — Prof. G. Brown Goode spoke on fisheries exhibitions, describing especially the international exhibitions at

Berlin (1880) and London (1883). — Mr. M. H. Doolittle began a communication, which was completed at the following meeting.

April 12. — Mr. M. H. Doolittle completed his communication on music and the chemical elements. The mathematical theory of music requires the satisfaction of the equation $2^x = 3^y$ nearly, in which, for equal temperament, x = the number of equal intervals in the octave, and y = the number of these intervals that correspond to a nearly perfect fifth; and, for untempered music, x = the number of approximately equal intervals in the octave, and y = the number corresponding to a perfect fifth. This equation gives $\frac{x}{y} = \frac{\log 3}{\log 2}$ nearly, = $\frac{176091}{1030}$ nearly; and, by the method of continued fractions, we obtain the succession of approximations, $\frac{3}{2}, \frac{7}{4}, \frac{21}{13}, \frac{31}{19}$, etc. For scales appropriate to major thirds, but disregarding fifths, we may substitute $\frac{4}{3}$ for $\frac{3}{2}$ in the above equations, and obtain the approximations, $\frac{1}{3}, \frac{2}{5}, \frac{13}{28}$, etc. For the chord having the vibration ratio 7:4 we may obtain in like manner the approximations, $\frac{4}{5}, \frac{31}{46}$, etc. The fraction $\frac{1}{\sqrt{2}}$, belonging to the first series, is the base of the chromatic scale, and, less directly, of the diatonic. The fractions $\frac{3}{2}$ and $\frac{4}{3}$, of the first and third series, probably represent all the five-toned scales of primitive music. Pentatonic, chromatic, and diatonic scales have thus a mathematical basis, and are in a proper sense natural. There is reason to believe that simple mathematical principles underlie the phenomena of chemistry, and that the quantitative relations of the elements are expressible in the derivatives of small prime numbers. There is, therefore, no *a priori* absurdity in looking for a correspondence of musical and chemical ratios. If the keys of a piano be arranged with seven consecutive keys in a line, the next seven in the next line, and so on, the columns give successions of musical fifths. It has been shown, that when the chemical elements are arranged in the order of their atomic weights, in lines of seven, the columns contain elements remarkably similar to each other. If the piano-keys be arranged in lines of twelve, the columns give octaves; but nothing is developed from a similar arrangement of the chemical elements. The general conclusion was reached, that there is no deep significance in the coincidence of the number seven in the diatonic scale and in the chemical groups. — Mr. Henry Farquhar then reviewed the theoretical discussion in Professor Tait's article on mechanics, in the Encyclopaedia Britannica, dissenting from several of his positions.

NOTES AND NEWS.

THE 'circulars' of Johns Hopkins university now appear so frequently, and with such varied and valuable contents, that they may already be looked upon as among the most important contributions to learning in our country. This is the more remarkable as no less than five important serial publications are issued under the auspices of the university, and in large measure are devoted to contributions from its

members. Baltimore has thus taken its place as one of the leading centres of science and learning in our country, and bids fair soon to outstrip older centres in the renown which must follow. The circular for April follows hard after that of March; and we notice in it a number of interesting facts, with abstracts of valuable papers which give an insight into the intellectual delights and activities surrounding the young university. Dr. Brooks gives an outline of the work of the Chesapeake zoological laboratory, from its beginning six years ago, dwelling especially upon its service in studying the propagation of the oyster. The lecture of Dr. Martin on modern physiological laboratories, and the account of that lately constructed for the university, are reprinted from *Science*. Reviews or analyses of books published by the officers of the university, and abstracts of papers in philology, history, mathematics, and other branches of science, fill up a large part of the number. We observe that an attempt is to be made to construct a map of the region about Baltimore, including about six hundred square miles, on the scale of two inches to a mile, based mainly on work already effected by the U. S. coast-survey.

—After the U. S. fish-commission steamer Albatross left Aspinwall, April 2, a line of soundings was started for Old Providence Island, about 250 miles distant. Casts were made at intervals of from ten to twenty-five miles. Starting with 707 fathoms, 17 miles from Aspinwall, the water shoaled to 611 fathoms at 27 miles, reached the maximum, 1,900 fathoms, 77 miles from port, and then shoaled gradually to 339 fathoms close to the reef off Old Providence.

On leaving Catalina harbor, on Old Providence Island, April 9, the Albatross laid a course for a doubtful bank 109' distant, in latitude $14^{\circ} 53'$ north, longitude $80^{\circ} 20'$ west, sounding at intervals of about eleven miles. The water increased gradually in depth to 1,151 fathoms on the reported bank, where it was supposed to break at times. The spot was carefully located by astronomical observations. After crossing a bank lying between Thunders knoll and Rosalind bank, a course was laid north-west for a vigia marked on hydrographic-office chart No. 394 in latitude $18^{\circ} 30'$ north, longitude $83^{\circ} 16'$ west. The depth gradually decreased to 920 fathoms, 75 miles from Thunders knoll, then suddenly increased to 3,169 fathoms at 105 miles. This was the greatest depth found in the Caribbean, and the sounding was made under adverse circumstances. On the first trial, the stray line parted, after something over 200 fathoms had run out, the sounding-rod, water-bottle, and shot being lost. It is difficult to explain this accident, unless it is to be attributed to a shark or some other fish; as the strain on it at the time did not equal one-tenth of its tensile strength. On the second attempt, all the wire was run off the reel without reaching bottom; and the shot had to be reeled in, more wire added, and finally the sounding taken. The bottom was a light yellow ooze, with a trace only of foraminifera.

The currents, which had been light since leaving Old Providence, now became strong and irregular.

On reaching the position assigned to the vigia, 66 miles from the deep sounding above mentioned, a sounding was taken in 2,829 fathoms. While making this distance, and taking two intermediate soundings, the vessel was so beset by strong and erratic currents, that it was only by locating each position astronomically that it could be kept anywhere near the desired locality. If these currents have been encountered by other navigators, who were steering a course without taking hourly observations, a very brief period would be required to take them sufficiently out of their reckoning to account, not only for the vigia mentioned, but the soundings of H.B.M.S. Phoebe and Rosario to the eastward of Misterioso bank, which was itself, doubtless, reported in a multitude of positions before it was finally located on the charts of to-day. From this point, the Albatross sailed for Key West by way of Cape San Antonio, reaching port, April 15.

—The annual session of the American oriental society was held in Boston, May 7. Since the last meeting, the society has lost by death an unusually large number of its members; its president, Hon. S. Wells Williams, and Dr. Ezra Abbot, being among the number. Dr. Abbot, who resigned his office two or three years ago, had served the society as recording secretary for more than thirty years. Tender and appropriate tributes were paid to the memory of both of these men; the former having been the foremost Chinese, and the latter the foremost biblical, scholar of America. In the election of officers, Professor Whitney of New Haven was chosen president, and Professor Lanman of Cambridge, corresponding secretary. Baltimore was selected as the place for the next meeting.

Nine papers were presented to the society, four of which discussed Sanskrit topics. Prof. C. R. Lanman gave an account of Protap Chundra Roy's enterprise in furnishing gratuitous editions and translations of the ancient Hindu classics, noticed elsewhere in our notes. He also read a paper on one of the spurious stanzas of the Rig Veda (10, 18, 14), illustrating by remarks on the stanza the subject of Vedic criticism. Professor John Avery of Brunswick, Me., presented a paper on the unaugmented verb-forms in the Rig Veda and the Atharva Veda. Professor Whitney, who read a paper on the study of Sanskrit *versus* that of the Hindu grammarians, showed that a study of the literature itself is the only proper way to learn Sanskrit. He gave many illustrations of the artificial and arbitrary character of the grammars.

Prof. I. H. Hall of Philadelphia gave some notes on a Cippus from Tarsus, now in the Union theological seminary at New York, bearing a Greek inscription. He pointed out that the name Paul, which occurs in the inscription, cannot, as has been supposed, be that of the great apostle. Professor Hall read a second paper on a Shapira roll in Philadelphia. He thinks that no part of this Hebrew document can be older than the last century, while part of it possibly belongs to the present century. The remarkable fact about it is, that an age of more than a thousand years has been assigned to it, which would make it the oldest known Hebrew manuscript. This great

antiquity is supported by a letter from the celebrated Tischendorf. It appears that the late Mr. Shapira, so noted for his dealings in antiquities, palmed off on some too credulous purchaser the Philadelphia roll, aiding himself in the fraud by a letter which Tischendorf had intended to apply to two other rolls. Professor Hall gave, also, some notes on Cypriote inscriptions in the New-York metropolitan museum.

A paper was read from President W. A. P. Martin of Peking, on the northern barbarians in ancient China. Dr. Carl Lehmann of Hamburg read a paper on the relation of *n* to *sh* in proto-Babylonian (Sumero-Akkadian). The fact that *n* in one of the dialects corresponds to *sh* in the other, the reader accounted for by the aid of the transitional sounds *l* and *r*, and he adduced support for his view both from Indo-European and from Semitic grammar. Prof. D. G. Lyon of Cambridge made remarks on some recent Assyrian publications, mentioning his own '*Keilschrifttexte Sargon's*,' Delitzsch's '*The Hebrew language viewed in the light of Assyrian research*,' Haupt's '*Das babylonische Nimrodepes*,' Strassmaier's '*Alphabetisches verzeichniss*,' and Bezold and Hommel's '*Zeitschrift für keilschriftforschung und verwandte gebiete*.'

—Quintino Sella, the Italian statesman and *savant*, who died at Biella, March 14, and was buried at Oropa, was born at Mosso, near Biella (Piemont), July 7, 1827, and was named 'the fifth,' as holding that number in a family of sixteen children. His father was a wealthy woollen manufacturer, and he was educated as a mining-engineer at the School of mines in Paris. His scientific works, although few, are all remarkable for their accuracy and acuteness of observation, showing the true spirit of original research. From 1857 to 1861 he published several memoirs on crystallography, — '*Sulle forme cristalline di alcuni sali di platino e del boro adamantino*,' and '*Sulle forme cristalline di alcuni sali derivati dall'ammoniaca*;' later, two important geological and technical descriptions of the valley of Biella and the mining industry of the Island of Sardinia, and also his '*Lezioni di cristallografia*.'

Sella was one of the three founders of the '*Club alpino Italiano*,' October, 1863, and its president at the time of his death. On the 17th of July, 1865, in company with his lifelong friend, Felice Giordano, director of the geological survey of Italy, Sella undertook the climbing of the Matterhorn (Sylvio or Cervin) from the Italian side, starting from Breuil in the Val Tournanche. After an unsuccessful attempt, they reached the summit only three days after the celebrated ascension of Whymper and his unfortunate companions. As president of the Reale accademia dei lincei of Rome, he remodelled entirely this old scientific institution, which was removed in January last to the celebrated palace Corsini. He was also president of the International geological congress at Bologna, 1881; corresponding member of the Institut of France; and foreign member of the Geological society of London.

As a statesman, Sella ranked among the first. He was thrice secretary of the treasury, and chief of the

constitutional party of the right. On his first appointment to the treasury, in March, 1863, he found Italy on the verge of the greatest financial difficulties, if not of a catastrophe; but, by his good management, in less than ten years he restored the Italian exchequer to a normal condition, balanced the expenses with the receipts, and has been justly called, by the president or speaker of the house of representatives, the '*Salvator del l'onore d'Italia*.' The '*Camera dei deputati*' has appropriated '100,000 lire, per un monumento alla memoria di Quintino Sella,' to be erected in front of the treasury (*Ministerio delle finanze*) at Rome.

—Protap Chundra Roy is a wealthy gentleman of Bengal, who has retired from business, and is devoting his leisure to the work of the Bharat Karyalya. This is an organization somewhat similar to the American tract society, but with a strangely different purpose. It is an institution for the printing and gratuitous distribution of the classics of India; the Mahā-bhārata, the Rāmāyana, and the Harivansa being the works first chosen. Already 13,783,500 printed forms have been gratuitously distributed, or are in course of distribution. Such a surprising result of well-directed and truly patriotic zeal deserves to be mentioned and recognized by all who are interested in the elevation and enlightenment of India, and especially by Sanskrit students in America. For Chundra Roy is now undertaking the publication of an English prose translation of the Mahā-bhārata in an edition of twelve hundred and fifty copies, two hundred and fifty of which, according to the generous and wide-reaching plans of Mr. Roy, are intended for the scholars of Europe and America. Sanskrit scholars, therefore, who desire to have their names placed on the free list, may forward their addresses to the publisher, No. 367 Upper Chitpore road, Calcutta, British India.

—Dr. Höpfner and a young scientific companion will shortly start for Ovamboland and the interior of Africa to explore for the Bremen geographical society. They have been supplied with instruments for astronomical observations by a member of the society: in return, they will send home periodical reports of their progress, and charts of the district explored. The same society is sending an expedition to Bonin Island, South Japan, to investigate its geography and natural history.

—At Ekhmeem, a large provincial town of Upper Egypt, situate about halfway between Assiout and Thebes, Professor Maspero, returning from his annual trip of inspection up the Nile, has just found, according to *Nature*, a hitherto undiscovered and unplundered necropolis of immense extent. As far as has been yet ascertained, the necropolis dates from the Ptolemaic period; but, as the work of exploration proceeds, it will probably be found that it contains more ancient quarters. The riches of this new burial-field would meanwhile seem to be almost inexhaustible. Five great tombs or catacombs, already opened, have yielded a hundred and twenty mummies; and, within the short space of three hours,

Professor Maspero verified the sites of over a hundred more similar catacombs, all absolutely intact. The necropolis of Ekhmeem, at a rough estimate, cannot contain fewer than five or six thousand embalmed dead. Of these, perhaps not more than twenty per cent will turn out to be of archeological or historical value; but the harvest of papyri, jewels, and other funeral treasures, cannot fail to be of unprecedented extent. Ekhmeem is the ancient Khem-nis, — the Panopolis of the Greeks. Its architectural remains are insignificant.

— The Alert, the store-ship of the Greely relief expedition, and the last of the vessels to sail, left New York, May 10. The Bear sailed from New York on the 24th of April, and reached St. John's, May 2; while the Thetis, the flag-ship of the fleet, and supposed to be the stanchest of the three, sailed from New York on that day, and reached St. John's on the 9th. Every thing that could be suggested in the way of equipment has been done for the party, and it is to be hoped that the pluck and discipline of the *personnel* will atone for their lack of experience.

— The subject of the thesis for the annual Walker prize of the Boston society of natural history, this year, was 'The life-history of any animal or plant.' Two essays only were offered in competition, and the first prize only was awarded: this was gained by Mr. Albert H. Tuttle, of the Harvard medical school, Boston, for a study of the embryology of *Lunatia heros*, with numerous illustrations.

Prof. A. E. Verrill has in press a very important paper entitled Second catalogue of Mollusca recently added to the fauna of the New-England coast and adjacent parts of the Atlantic, consisting mainly of deep-sea species, with notes on others previously reported. These are chiefly derived from the dredgings of the fish-commission, are well illustrated, and worked up in the full and careful manner characteristic of the author. It appears in the Transactions of the Connecticut academy of sciences, and is illustrated by Emerton.

— The annual report of the zoölogical gardens of Cincinnati states that over eight hundred animals are on exhibition, and that a hundred and twenty-seven were bred in the gardens last year, including a grizzly bear. The most noteworthy addition during the year was that of a young hippopotamus, which promises to become the main feature of the collection. Nearly twenty-eight thousand dollars were received from visitors' fees.

— The additions to the American museum of natural history in New York seem not to have been so numerous or important last year as in previous years. The museum has, however, received its first bequest (five thousand dollars, from Mr. W. E. Dodge), and makes it the occasion to establish a permanent endowment-fund. The absence of such a fund, and the absolute dependence of this fine museum upon annual subscriptions and grants, have been very weak points in its organization, and have seriously

disturbed its scientific friends. They will not be satisfied until it is permanently endowed.

— The New-York anthropological society was organized Dec. 28, 1883, the aim of which is to prosecute researches in the sciences of anthropology and psychology.

— In the third *Bulletin* of the Natural history society of New Brunswick, just issued, Mr. G. F. Matthew describes in detail the discovery and examination, by a small summer party belonging to the society, of a village of the stone age, at Bocabec, on Passamaquoddy Bay. Indications of the former site of over thirty huts were recognized, each of circular form, bordered by a raised edge of gravel, and surrounded by the shells of a kitchen-midden. A plan of the village, and a section of one of the more typical hut-bottoms, is given, together with descriptions of the various articles—including implements of stone, bone, and ivory, as well as pottery—found in and around them; and various conclusions are drawn as to their antiquity, and the habits, food, and ethnic relations of their former possessors. The *Bulletin* also contains a report of the botanical committee, giving a list of over eighty species first found in the province during the last year, and of which one (*Ornithopus scorpioides* L.) is probably new to America; and a list, the first authentic one yet published, of New-Brunswick mammals, by M. Chamberlain. It includes forty-three terrestrial, and five marine species. It is noticed, that, while the panther and wolf have nearly or quite disappeared, the Virginia deer (*Cariacus virginianus*), though still not common, is increasing.

— The New-Brunswick legislature, at its last session, appropriated two hundred dollars towards the assistance of the Natural history society of the province. This is the first recognition of the claims of the society upon the public for support, and will be of much service in helping to defray the cost of publication of their bulletins.

— Mr. G. F. Matthew, whose elaborate article on the Paradoxides of the St. John group is contained in the recently published Transactions of the Royal society of Canada, has in preparation, and will present at the next meeting of the society (May 20), a similar article on the Conocoryphidae of the same group.

— The California academy of sciences has commenced the issue of a new publication, called *Bulletin*, apparently to replace the former Proceedings. The papers in this first number are classified under zoölogy, botanic section, microscopic section, astronomy, and mineralogy, and are mostly very brief and descriptive in character.

— The Calcutta *Englishman* announces another important result in the investigation of the causes of cholera. Dr. Vincent Richards, civil surgeon of Goa-lundo, has succeeded in doing what the German commission have hitherto failed to accomplish: he has produced the disease artificially. The subjects of his experiment were pigs; and, after many trials, he communicated to one of them what appears to have been

genuine cholera, the animal having died within three hours after the cholera-poison had been administered.

—M. Pasteur and his *collaborateurs* have announced to the French academy that they can render all dogs absolutely proof against the effects of rabies by inoculation, however the virus may be administered.

—Under the heading 'Expeditions to the Kongo region,' the *Frankfurter zeitung* states, that, according to information obtained from a well-informed source, Dr. Passavant of Basle, and Dr. Pauli of Brunswick, arrived, at the end of February, at Madeira, where they met Dr. Chavanne of Vienna. The three travellers were to proceed almost immediately to Africa. Passavant and Pauli, who are travelling at their own expense, proposed to penetrate the interior from the Cameroon delta on the coast of Guinea. Dr. Chavanne, who was to be joined at Madeira by Dr. Lintgraf of Detmold, is, it is stated, directly employed by the king of the Belgians. He has been commissioned to trace the route for a narrow-gauge railway to connect the coast with Leopoldville and Stanley Pool. He intended to proceed directly from Madeira to Banana, and take as the point of departure for his expedition, "the mouth of a small river situated about 5° south latitude." Having completed the survey for the railway, he is to proceed in a north and north-east direction, to explore the course of the River Uelle; the object of this exploration being the establishment of a connection between the Kongo and the Nile. The country situated to the south of the Kongo is to be explored at the same time by Lieut. Wissmann, also on account of the king of the Belgians. Dr. Chavanne was to be joined at Banana by a hundred Zanzibaris; and seven hundred additional Zanzibaris were awaiting there the arrival of a steamer to be sent from Europe, in order to transport it, under the command of Belgian and English engineers, above the falls of the Upper Kongo, to be utilized in Dr. Chavanne's exploration.

—The *Athenaeum* of March 29 states that Couderau, J. Roche, and C. Demont have arrived at Para. They will devote two years to the exploration of the Amazon basin; paying particular attention to anthropology and natural history, without neglecting purely geographical and commercial questions. They travel under the auspices of the French ministry and marine.

—Dr. Nathorst, of the late Swedish expedition to Greenland, has just issued his report on the geology of Waigatt Strait, near Disco Island, and on the attempt of the Sofia to reach Cape York in 1883.

—The fourth volume of the *Meddelser om Grönland* has appeared, with important contributions to the knowledge of that region. Hammer contributes a study of Jacobshavn Fiord, made during the winter of 1879-80. Another chapter, on the glaciers of North Greenland, is the work of Steenstrup, who also reports on the deposits of nickeliferous iron ore, and on the geognosy and geography of a part of North Greenland. The book also contains researches on the composition of the native iron of Greenland, by

Lorenzen, and astronomical positions determined in North Greenland, by Steenstrup and Hammer. It is well illustrated, and contains a *résumé*, in French, of its contents, by Professor Johnstrup. The two succeeding volumes are in press, and will contain a study of the miocene and cretaceous fossils of North Greenland, with an account of the explorations made on the east coast of that country by Messrs. Vandel, Normann, and Holm.

—The royal society of Canada will hold its next annual session at Ottawa, May 20 and following days.

—The work of the Austrian geological institute has been carried on, the past year, by Stache and Teller, with the temporary co-operation of Berwerth and Baron Camerlander, in the central chain of the Tyrol and the easternmost portion of the frontier of Carnithia; by Mojsisovics, Bittner, and Vacek in the north-western part of Styria and in the revision of the calcareous Alps of Salzburg; by Paul and Uhlig in the Carpathians of Galicia; and by Tietze and Hilber in the other portions of Galicia. Von Hauer and Mojsisovics also examined the thermal springs in Baden (south of Vienna), whose temporary intermittence had caused grave apprehensions; and Mojsisovics visited Bosnia, Istria, and Trifail, in Styria, with reference to coal-deposits. Stur studied the coal-formation of Taworzny in Galicia, where the mines had been much damaged by the irruption of water. Paul examined several petroleum districts in Galicia and North Hungary, and searched for coal and salt deposits in the neighborhood of Tuzla in Bosnia, where a boring, executed under his direction, met, at a depth of ninety metres, water saline enough to be used for industrial purposes. Böhm investigated the glacial phenomena in the valley of the Enns. Frauscher studied the eocene faunas of the northern Alps of Upper Austria; Geyer, the *todtegebirge* of Upper Styria; and Tausch, the cretaceous deposits of Ajka. The library now contains about twenty-nine thousand volumes.

—The commission for the geological survey of Bohemia reports, that, during the past year, Krejci and Feistmantel studied the still imperfectly known western Silurian deposits, which are interrupted by great faults, parallel to the strike of the whole system, and causing a great number and diversity of synclinal and anticlinal foldings; Fritsch surveyed the Teplitz strata, near Podiebrad and Chrudim, and Kafka the Chlomek strata in Glatz; Laube continued his investigations in the metalliferous region of Kaaden and Komotau; the passage of the railway through this region proved that the anthracite zone of the Saxon Erzgebirge continues along the borders of the porphyritic region, at a distance of about five kilometres from the Saxon frontier. As is usually the case in the metalliferous regions of Bohemia, no traces of glacial action could be discovered.

—Mr. J. F. Whiteaves, paleontologist to the Dominion geological survey, has just issued art. iii. of vol. i., Mesozoic fossils, of the paleontological series of the survey, on the fossils of the coal-bearing beds

of the Queen Charlotte Islands, collected by Dr. George M. Dawson in 1878. The formation, by these data, is shown to be cretaceous rather than Jurassic, and is unconformably overlaid by tertiary strata, showing evidence of great disturbance, and supposed to be the representatives of the chief period of mountain-making for the region. The fossils are nearly all molluscan.

— The Marquis de Gregorio has recently published a number of paleontological notices in the *Naturalista siciliano*, which chiefly relate to tertiary forms, especially members of the family Pectinidae, of which, and of the Ostreidae, he has made a special study. He has also proposed, should four hundred subscribers offer themselves, to bring out an international geological and paleontological journal, the articles to be in the languages of the respective authors, and to be copiously illustrated. A bibliography, in French, of geological literature, would form a prominent and useful feature of the proposed journal.

— At the meeting of the Royal astronomical society in March, Dr. Gill, director of the observatory at the Cape of Good Hope, gave the following account of his arrangement with Dr. Elkin, which resulted in the measurements of stellar parallax already described in *Science*: "When I was in Strasbourg in 1879, before going to the Cape, I met a young student, Dr. Elkin, a pupil of Professor Winnecke. He was then engaged in writing his dissertation on the parallax of α Centauri, and he requested me to send him observations, which might have been made at the Cape, of that star. At the same time, I told him that I had acquired by purchase Lord Lindsay's heliometer, and intended to have it mounted equatorially at the Cape, to carry on the work of investigation of stellar parallax. This seemed to fire his enthusiasm, and he expressed a great desire to go with me and share my work. I said I could offer him no position, and he replied that he did not want one. So I said, 'If you will be my guest, and come and live with me and share my work, you will be most welcome.' He said he should be happy to do so, and he came to me so soon as he had taken his degree. So we have undertaken a certain amount of work together, and I should like to give a short account of it."

In the account which follows, he refers to the parallaxes of α Centauri and Canopus. The result was about $0.75''$ for α Centauri, which shows it to be the nearest known fixed star to our system, though farther than was formerly supposed. The most curious result, however, is that for Canopus, or α Argus, which is, next to Sirius, the brightest star in the heavens, and might therefore be supposed among the nearer ones; but the resulting parallax is only $0.03''$, a quantity too small to be relied upon. It would therefore seem that this star is probably ten times the distance of Sirius. In the same connection, Dr. Gill presented to the society an unpublished investigation by Struve, at Pulkova, which gave a parallax of $0.5''$ for Aldebaran, a star which no one seems to have before attacked for parallax purposes.

— Professor Pickering, whose work in stellar pho-

tometry is so widely known, during his last summer's visit to European observatories was very fortunate in discovering valuable unpublished manuscripts of a large part of the photometric work of Sir William Herschel. First in importance were two unpublished catalogues, which, with the four published in the *Philosophical transactions* of the Royal society, complete the determination of the brightness of all the stars of Flamsteed's catalogue at a time when no other estimates of their magnitudes are known to exist (about a hundred years ago). Professor Pickering's reduction of these catalogues by comparison with a uniform photometric scale (the logarithm of whose light-ratio is 0.4) has shown that Herschel's estimates of magnitudes were much more accurate than has been generally supposed, thus rendering the discovery of the two additional catalogues all the more valuable.

Of much importance, too, was the discovery of the journal of the original comparisons, whose results are contained in all six of these catalogues, thus giving the date of each comparison. At the suggestion of Mr. Chandler, whose forthcoming bibliography of variable stars will be of great value, the observations of the variable stars contained in this journal have been examined with the idea of correcting or checking the periods of some of the well-known variables by these older observations; and the results are given in a paper recently presented to the American academy of arts and sciences by Professor Pickering. The periods of many of the later discovered variables are so irregular, or so little is known of them, that Herschel's observations of these cannot be utilized till these periods are better determined from further observation or discussion; and thus, much of the value of these old observations is still to be determined in the future; but it is well to know that they are now accessible. In the case of two or three of the variables, however, they are sufficient to give corrections to the periods which are of some value, and would be still more so if Herschel had only given the hour, as well as the night, of observation. As it is, the times can only be fixed between the limits of twilight and rising or setting of the star, unless, as the writer would suggest, the order and number of the observations in any one night might fix the limits of time a little more closely in some cases.

— It may not be generally known in the United States, that the publication of the *Journal de zoologie* and of the *Revue et magasin de zoologie* has ceased; that of the former in consequence of the death of Professor Gervais, of the latter for other reasons. As the *Bulletin* of the *Société zoologique de France* covers the scope of these journals, and as the *Société* is very desirous of entering into relations of exchange with the American institutions, it is suggested by the secretary of the Smithsonian institution, that the transfer in question of the address should be made. The institution, as heretofore, will take much pleasure in transmitting parcels addressed to the *Société zoologique*, or to any other of the learned bodies of France.